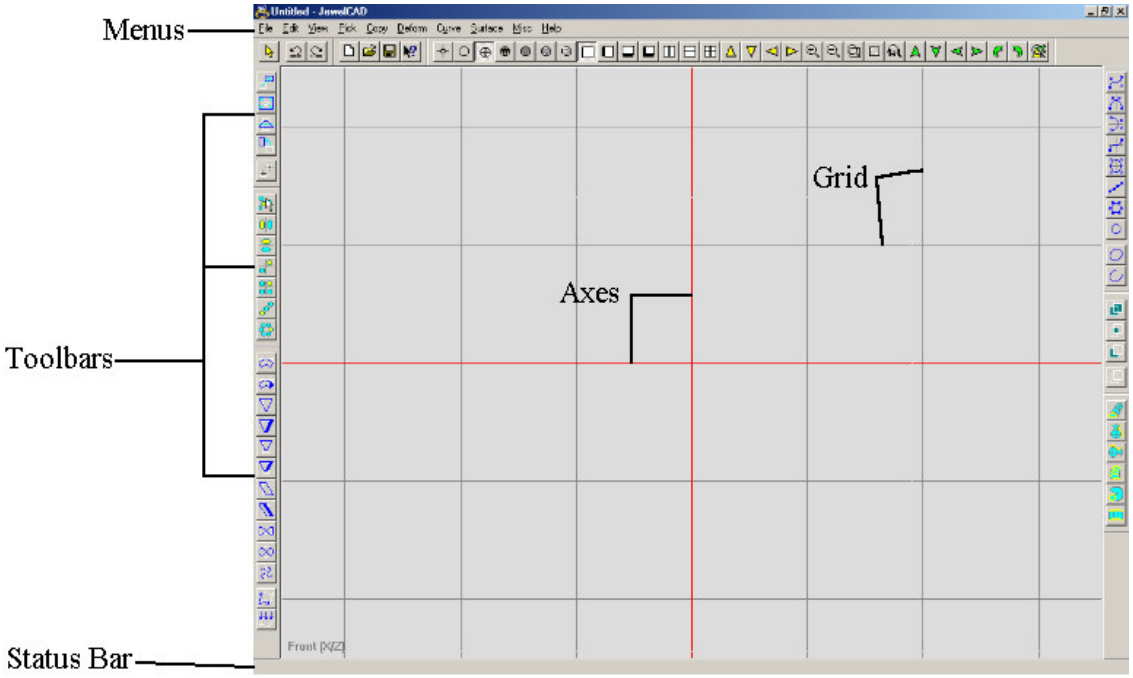
INTRODUCTION

This manual is laid out in a logical progression of a model construction. Beginning with the database; manipulating objects; then on to drawing of 2D curves. Converting those curves into 3D objects, and then copying, cutting/joining objects and finally slicing for production.

When JewelCAD is opened, the screen should look something like this:



The default settings have the grid at 10 units each. The positions of the toolbars can be changed by holding the left mouse button down over a toolbar (but not clicking on a button) and dragging the toolbar to its new position.

+ Left Mouse Button (LM) and drag.

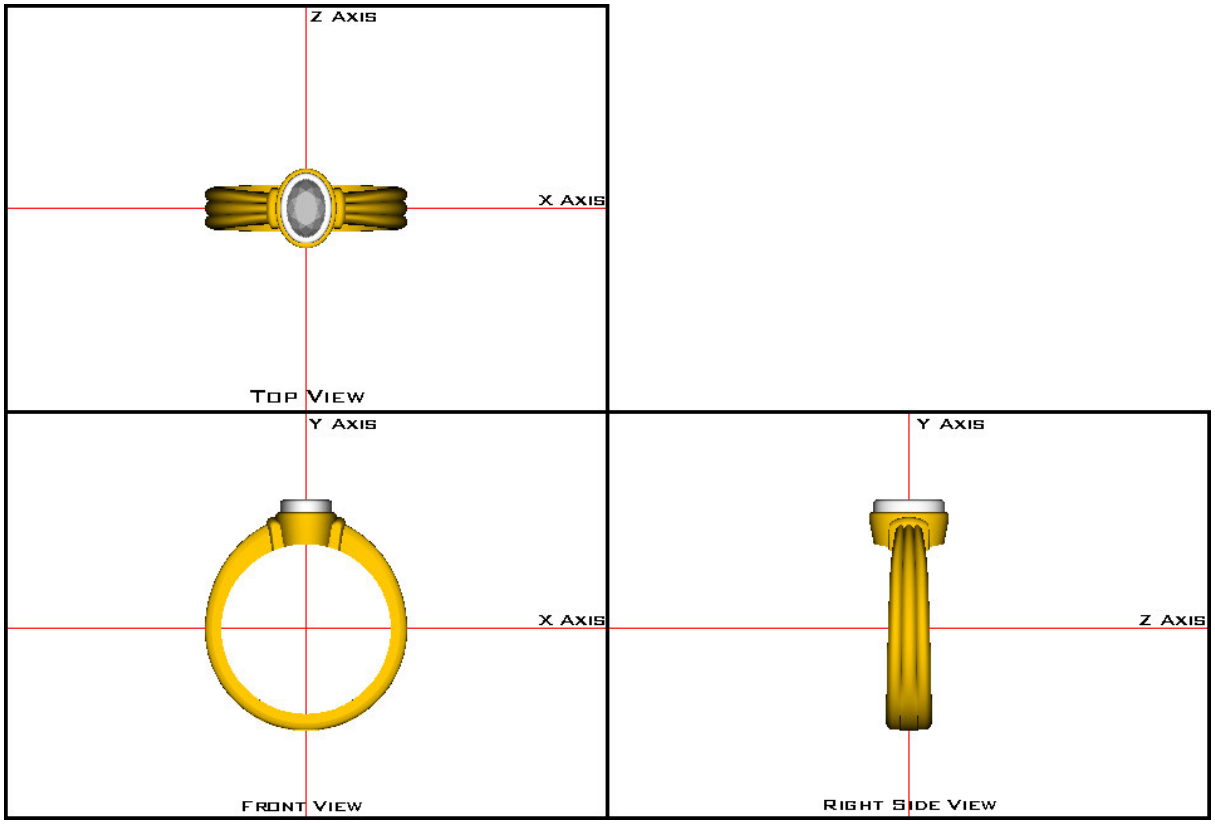
All of the buttons shown are shortcuts for functions, which can also be activated using the drop-down menus. The buttons are grouped according to their menu. Ie: Copy Menu contains Cut & Paste, Vertical Mirror Copy etc, Copy toolbar contains these as well.

There is a table of buttons, with a short description of their uses at the back of this manual.

THE CAD WORLD

The "world" in JewelCAD is just like ours: 3-Dimensional. Everything in JewelCAD has three references: X, Y and Z. The computer uses dimensions in these 3 axes ,(co-ordinates), to define points on the objects.

The views are standard 3rd-angle orthographic projection. Ie:



The X-, Y- and Z-axes run through these views as follows:

Front View: X-axis is horizontal, Z-axis is vertical
Top View: X-axis is horizontal, Y-axis is vertical
RS View: Y-axis is horizontal, Z-axis is vertical

There is a "centre" to this world, called the World Origin, where the axes meet.
Most of the functions work with the World Origin as a reference point.
When drawing in CAD, you must remember that the drawing is **ALWAYS** 3D. What you do in one view may very well alter another view.

Also, it is important to remember that 'drawing' on a computer is not like drawing with paper and pencil. Everything on the computer must be accurate. You cannot, for example, extend a line by drawing another on top of it, as you might on paper. If you wish to join 2 lines, you must follow a 'formal' procedure, it is not sufficient to draw one from the end of the previous. If you are asked to 'close' a curve, this must also be done by the set procedure, and not by placing a point on top of another. This is an important feature of 3D modelling.

JEWELCAD ENTITIES

CV:

Control Vertices. The points that JewelCAD use to define the shape of the objects and curves .

CURVE:

The general term for 2D shapes, which can be straight lines, circles, curves etc.

SURFACE:

A 3D object constructed from 2D curves.

T-LINE:

Construction lines used to define general boundaries. Cannot be altered once set

JEWEL:

An object, whose shape is already set and can only be altered by the Transform functions (Move/Size/Flip/Roll)
(see "Miscellaneous Menu")

BOOLEAN OBJECT:

An object made by the joining of 2 or more objets by a Boolean operation. (see "Boolean Menu")

BLOCK:

An object made by the Block function. Has no CVs, and can only be altered by the Transform functions.
(see "Miscellaneous Menu")

FACET OBJECT:

An imported object, usually from STL or DXF format.

FILE MENU

NEW:

Clear screen and start a new JewelCAD drawing.

Hotkey	Hit [Ctrl + N] keys to create a new drawing

OPEN:

Clear screen and open an existing drawing

Hotkey	Hit [Ctrl + O] keys to open an existing drawing

INSERT:

Bring an existing drawing into the present drawing

SAVE:

Save drawing as the current open JewelCAD file

Hotkey	Hit [Ctrl + S] keys to save a drawing

SAVE AS:

Save drawing as a new JewelCAD file

SAVE VIEWS:

Save the present View as a .BMP file

DATABASE:

Open the Database

Hotkey	Hit [B] key to open Database

IMPORT:

Bring a file of a different format (ie. STL, DXF etc) into the drawing

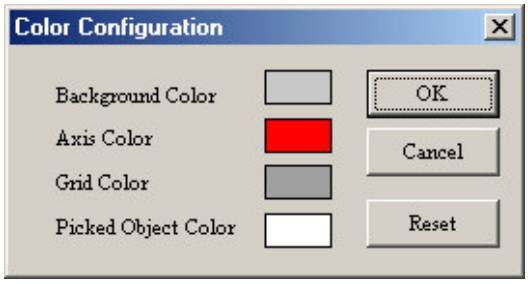
EXPORT:

Save the present drawing as a different format (ie. STL, DXF, IGES, JCV etc)

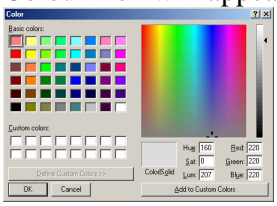
CONFIGURATION:

Colours:

Change the colours of Axes, Picked Colour etc



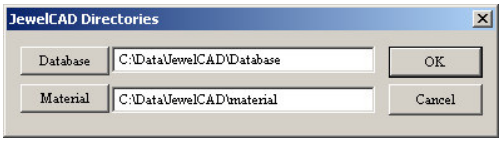
1. Click on colour to be changed
2. Colour Box will appear.



3. Choose new colour and click "OK"

Directories:

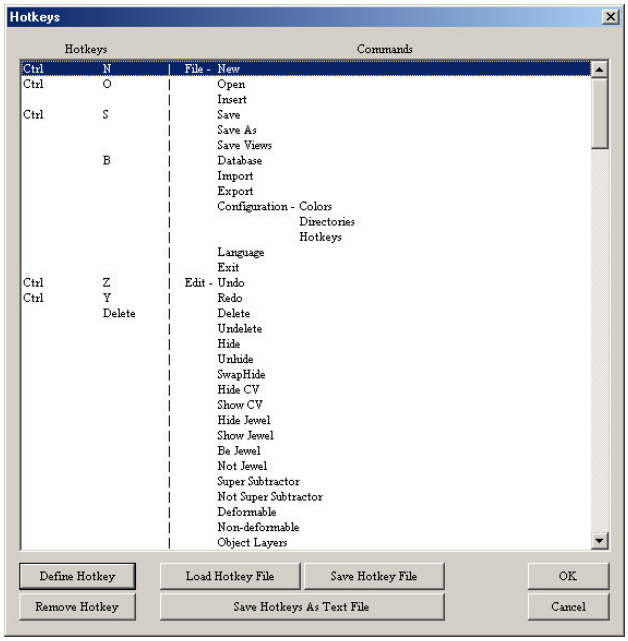
Change the location of the database and material directories. Click on the "Database" and "Material" buttons to browse for the location.



Hotkeys:

Change/create new hotkeys.

1. Select the function you want to set/change the hotkey for.
2. Click on "Define Hotkey".
3. Hotkey window will appear.
4. Change letter and chose whether a **Ctrl** or **Shift** has to be held at the same time.
5. Click "OK".



Load/Save Hotkey File:

Allows you to save the hotkey setup. Good for multiple users of the one program. Each user can have his/her own hotkeys.

To Save hotkey file:

1. Click on Save Hotkey File button
2. Change "Save In" box to drive, folder etc where you want to save it.
3. Type name for file in "Filename" box. Eg. Bobskeys.hky
4. Click "OK"

To Load hotkey file:

1. Click on Load Hotkey File button
2. Browse to find the file.
3. Select hotkey file
4. Click "OK"

LANGUAGE:

Allows you to change the language used in the program. Default is English. Can choose between Traditional and Simplified Chinese, French, German and Greek

EXIT:

Exits the program

Hotkey	Hit [Alt + F4] keys to close JewelCAD

EDIT MENU

UNDO:
Un-do the previous action. Does not undo View changes.

Hotkey	Hit [Ctrl + Z] keys to undo the last action

REDO:
Re-do an action. Redo list is wiped when, after undoing, another operation is performed.

Hotkey	Hit [Ctrl + Y] keys to redo the last action

DELETE:
Delete all selected objects. Does not work on CVs.

Hotkey	Hit [Delete] key to delete selected objects

UNDELETE:
Undo the previous delete action.

HIDE:
Move objects into the main hidden layer.

UNHIDE:
Move all objects from the main hidden layer into the visible layer.

SWAP HIDE:
Swap the contents of the hidden and visible layers

HIDE CV:
Hide the CVs of a curve or surface.

SHOW CV:
Show the CVs of a curve/surface.

HIDE JEWEL:
Move all objects designated as Jewels to the hidden layer. Includes jewels brought in by the Misc > Jewel function and objects designated as a Jewel.

SHOW JEWEL:
Move all objects designated as Jewels to the visible layer.

BE JEWEL:
Designate an object as a Jewel

NOT JEWEL:

Designate an object as not a Jewel

SUPER SUBTRACTER:

Make the selected object a super subtractor. IE removes material from other objects without the need for Boolean operation

NOT SUPER SUBTRACTER:

Make the selected object cease to be a Super Subtracter

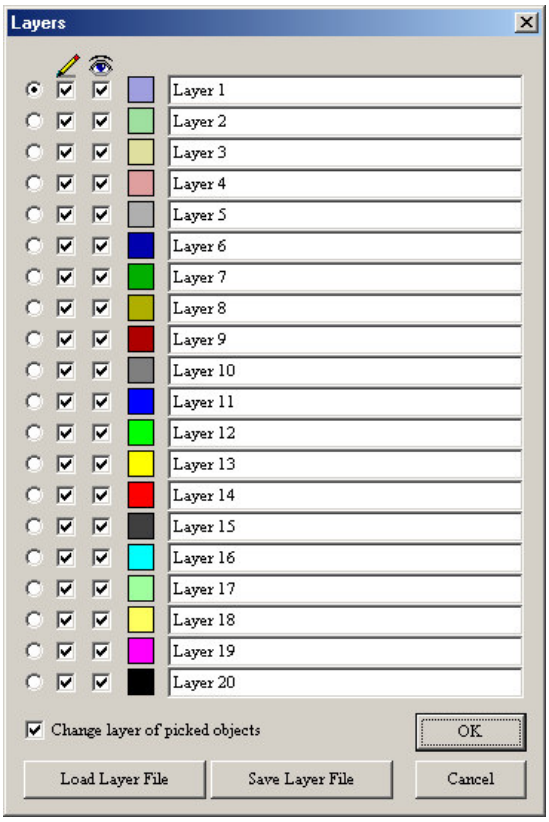
DEFORMABLE:

Make the selected objects deformable

NON-DEFORMABLE:

Make the selected objects non-deformable. Ie: the object itself will not be altered by the deform functions, or by projection operations.

OBJECT LAYERS:



Assigns an object(s) to a layer. Useful for defining object groups.
Every layer has a "Visible" and "Editable" property. Make sure these are turned on/off as required.
To move an object to a hidden layer:

1. Select Object
2. Click on Edit > Object Layer
3. Make sure that "Change Layer of Picked Object" is ticked
4. Select layer to move object to.
5. Change name of layer, if required. Eg: "Setting"
6. Click "OK"

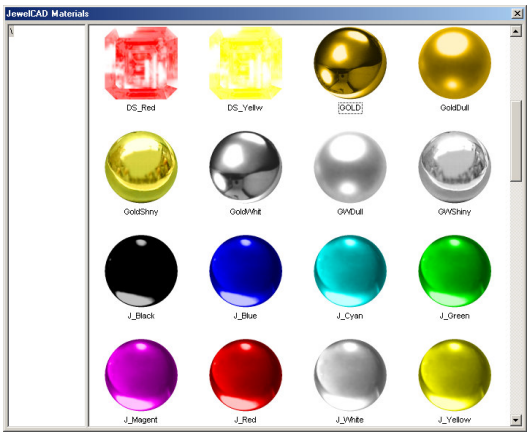
If the object layer is still set to visible, the wires of the object will be the colour of that layer.

Load/Save Layer File:

Saves the Visible/Editable/Name properties of the layers. Good for multiple users, each user can have his/her own setup of the layers.
To Save/Load layer properties:

1. Click on Load/Save Layer File button
2. Change "Save In" box to drive, folder etc" where you want to save to/load from. To Load, select file to load. To Save, type name in "Filename" box.
3. Click "OK"

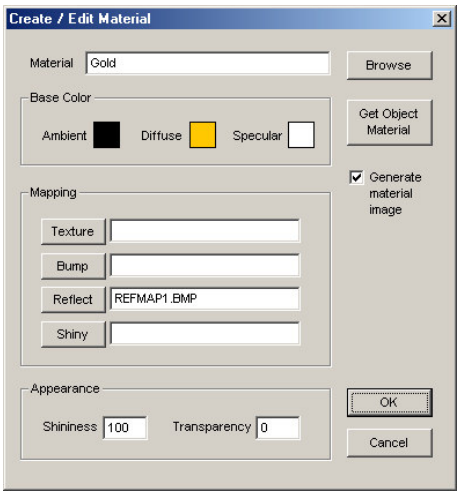
MATERIAL:



Opens the Material Database, allowing you to change the object's material.

1. Select object to change.
2. Select "Material"
3. Click on new material.

CREATE/EDIT MATERIAL:



Opens a dialogue box for creating new or editing materials.

Base Colour:
Click on colour box to change.

Get Object Material:
Click to retrieve an existing object's material settings.

Mapping:
The images used to create the illusion of texture etc. (.BMP)

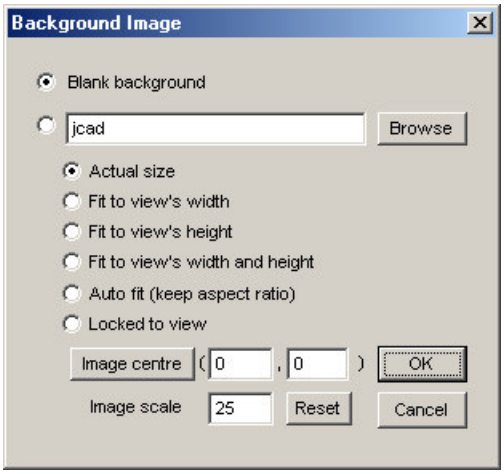
Appearance:
Alter outside appearance.

VIEW MENU

As everything in JewelCAD is always 3D, the drawing can be viewed from any angle. The View Menu allows you to chose the way you want to look at an object, including direction, shading, and zooming.

BACKGROUND:

To change the look of the background, or to trace a scanned object.



Blank Background: Uses the default background.

Otherwise:
Click "Browse" to locate a picture for the background.

Actual Size:
Shows the image at actual size

Fit to View's Width:
Resizes the image proportionally until it is the same as the view's
width.

Fit to View's Height:
Resizes the image proportionally until it is the same as the view's height.

Fit to View's Width and Height:
Resizes the image until it is the same as the view's width and height. (Note: this will distort the image.)

Auto Fit:
Resizes the image so it just fits inside the view. Does not distort the image.

Locked To View:
Locks the image to the view, so image will be panned and zoomed together with the view.

Image Centre:
Allows you to determine which part of the image is at the world origin.

1. Click the "Image Centre" button. The menu will disappear.
2. Hold the mouse button down and drag to where you want the new centre to be
3. Release mouse button.

Image Scale:
Allows you to scale a picture from its original size.

Reset:
Resets the Image Centre and Image Scale figures to the default settings.

GRID SETTINGS:

Allows you to alter settings for the grid.

Grid Spacing: default is 10 units.

No Grid: removes grid from drawing. Axes will remain.

FINE SNAP:

Increases the resolution of the snap function. (usually off for most operations)

Hotkey	Hit [Z] key to activate Fine Snapping

COLOURINGS / VIEWS:

The different colouring modes	Hotkeys
NORMAL WIRE FRAME:	W
QUICK WIRE FRAME:	Q
MESH WIRE FRAME:	E
FAST SHADING:	A
SHADING IN COLOUR:	S
RENDERING:	D

The different viewing directions	Hotkeys
FRONT VIEW (X/Y):	F
RIGHT VIEW	R
TOP VIEW	T
BACK VIEW	K
LEFT VIEW	L
BOTTOM VIEW	M
3 DIMENSIONAL VIEW	3
FRONT AND RIGHT VIEWS	
FRONT AND TOP VIEWS	
FOUR VIEWS (Front/Top/Right/3D)	
FOUR VIEWS (Back/Left/Bottom/3D)	

Click on the buttons to change between views / colourings.

NEW VIEW:

Opens a new view window

PAN VIEW:

Moves the view either Up, Down, Left or Right

Hotkey	Hold [Tab] + [Ctrl] keys down. Click Left mouse button and drag to Pan

ZOOM VIEW:

Zooms in or out.

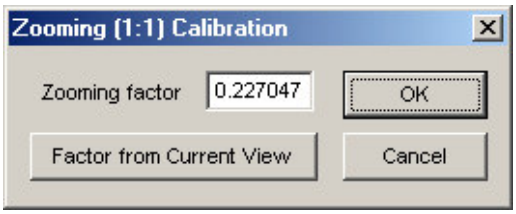
Box:
Use a box to zoom a specific area.
Click and hold where you want the new centre of the view to be and drag away.

All:
Zoom so all objects, regardless of position, are visible in one view

1:1:
Zoom to actual size. Requires calibrating.

Calibrate:
Calibrates the 1:1 zoom.

1. Zoom In/Out until grid is 1cm on the screen. Use a ruler to measure it.
2. Select Calibrate and click "Factor from Current View" then "OK".



Hotkey	Hold [Tab] key down. Click Right mouse button and drag to Zoom

FLIP VIEW:

Flips 3D view up/down, left/right

ROLL VIEW:

Rolls 3D view to the left/right

RESET VIEW:

Changes View back to default, regardless of objects' positions.

TOOLBARS:

Allows you to choose which toolbars are shown. Click name to activate/de-activate.

Reset: Resets toolbars to default

PICK MENU

In order to work on an object/curve/cv, it must be 'selected'/'picked'. The default colour of a picked/selected object is white.

SELECTING METHODS:

Clicking:

To select

1. Move the curser over one of the lines and click the Left Mouse Button.
2. Continue clicking on other objects to select them too.

To de-select

1. Click on a selected (white) line: object will turn pale blue.
2. To de-select all objects, click Right Mouse Button.

Dragging:

To select

1. Hold mouse button down and drag box through object lines.

To de-select

1. Hold mouse button down and drag box through object lines: object will turn pale blue.

De-select all objects:

Click the right mouse button anywhere on the screen.

PICK:

Allows you to select/de-select entities. The "Normal" state of JewelCAD.

Hotkey	Hit [Spacebar] to return to Picking mode

PICK CV:

Allows you to select/de-select CVs individually. Used to edit surfaces and curves.

Hotkey	Hold [Shift] Key down to Pick CVs. Release [Shift] key to return to Picking mode

PICK T-LINE:

Allows you to select/de-select T-Lines

ALL:

Select everything

CURVE:

Select all curves

SURFACE:

Select all surfaces

BOOLEAN:
Select all Boolean objects

BLOCK:
Select all Block objects

JEWEL:
Select all Jewels

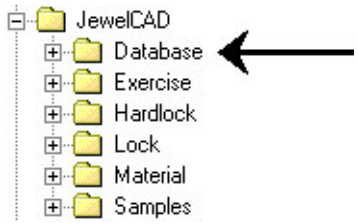
FACET OBJECT:
Select all Facet Objects (eg imported STL files)

T-LINE:
Select all T-Lines

DATABASE:

LOCATION:

The files in the JewelCAD database are located in the JewelCAD directory, in the database folder:



Files are in here….

The directories/names you see in the database are the same as in Windows Explorer.

The contents and names in the database can be altered through Windows Explorer.
See "File Menu – Directories" to change location.

ACCESSING THE DATABASE:

To access the database through JewelCAD, press the "B" button or, using the menus:

File > Database

ADDING TO THE DATABASE:

To save a drawing (complete or unfinished) to the database:

1. File > Save As
2. Change the "Save in" box to the "database" directory, then whichever directory within.
3. Type a filename in the "File name" box.
4. Click "OK".

SAVING PICTURES TO THE DATABASE:

When a drawing/part is saved to the database, a picture must also be saved separately.
After saving the JewelCAD file as above:

1. Render the model and set to 3D view.
2. misc>render to file
3. Change the "Save in" box to the "database" directory, then whichever direc tory the JewelCAD drawing is in.
   Type the same filename as the JewelCAD drawing, it will be automatically designated a .BMP file.
4. Click "Save".

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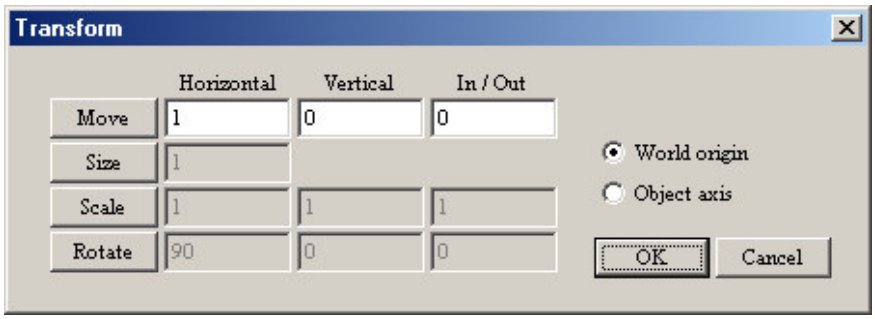
TRANSFORM

The Transform functions allow you to move, rotate and resize objects.
The functions, with the exception of Roll, also have a secondary function, available by using the right mouse button instead of the left.

The Transform functions are also available through the Deform > Transform menu. Through the menu, you can specify a definite distance/angle etc to move the object, as well as being able to combine functions.



Move:
Moves the object the distance specified along each axis

Size:
Resizes the object in all axes in proportion, by this MULTIPLYER

Scale:
Resizes the object along each axis separately by the MULTIPLYER in each box

Rotate:
Rotates the object AROUND the axis in which the angle is typed.

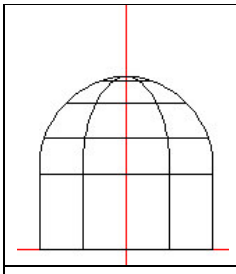
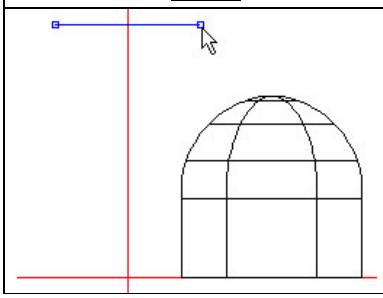
World Origin:
Use the World Origin as the reference point for the functions.

Object Axis:
Use the Object Axis as the reference point for the functions.

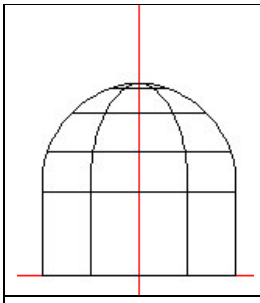
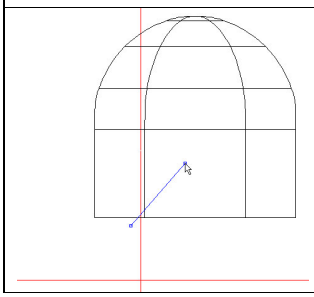
Combining Functions:
To combine functions (eg roll 30º move up 10mm and resize x2 all at once), can be used simultaneously by selecting the relevant function button.

MOVE:

Left Mouse Button:

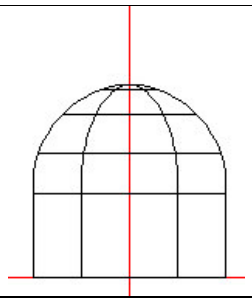
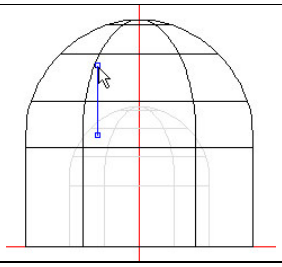
	Select Objects (or CVs)
	Click on Move button
	Click and hold left mouse button down and drag to new position. Will move either vertically or horizontally.

Right Mouse Button:

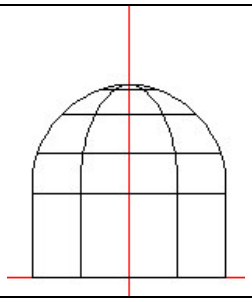
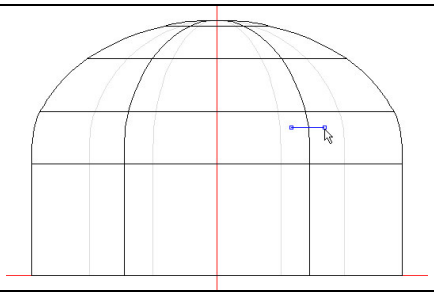
	Select Objects (or CVs)
	Click on Move button
	Click and hold right mouse button down and drag to new position. Will move in any direction.

SIZE:

Left Mouse Button:

	Select Objects (or CVs)
	Click on Size button
	Click and drag horizontally or vertically. Changes along all axes proportionally.

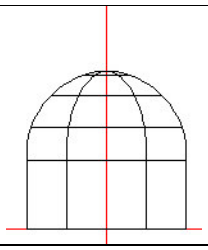
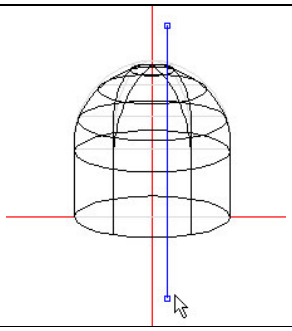
Right Mouse Button (Scale):

	Select Objects (or CVs)
	Click on Size button
	Click and drag horizontally or vertically. Will resize only one dimension.

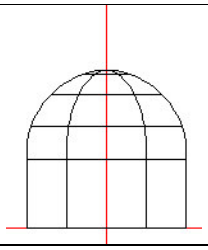
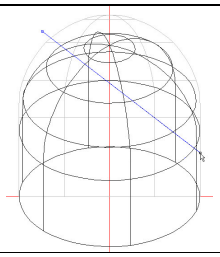
Size and scale both work by proportion, from the world origin. (X0Y0Z0). Therefore, if they are remote from the world origin they may move when being changed. This can be avoided by setting clicking 'deform'>'object axis'

FLIP:

Left Mouse Button:

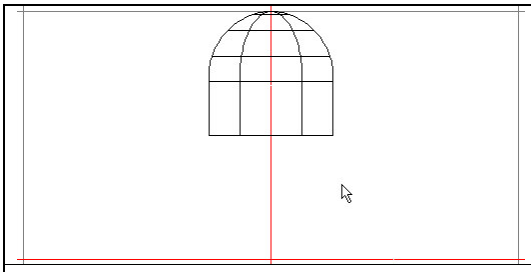
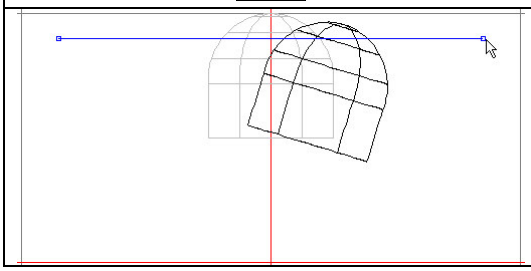
	Select objects (or CVs)
	Click on Flip button
	Click and drag across horizontal/vertical axis. Will flip around the axis you cross.

Right Mouse Button:

	Select objects/ (or CVs)
	Click on Flip button
	Click and drag. Will combine the up/down flip with the left/right flip..

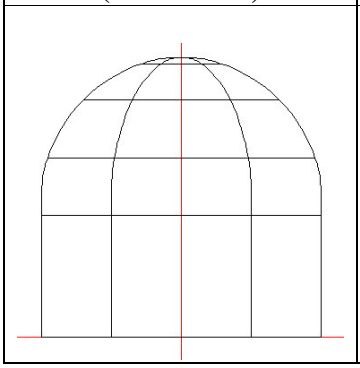
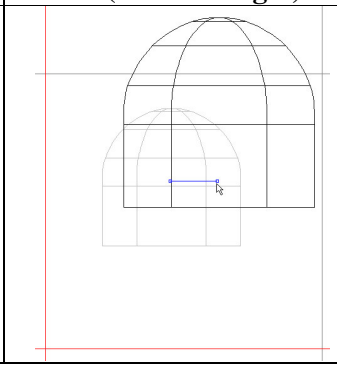
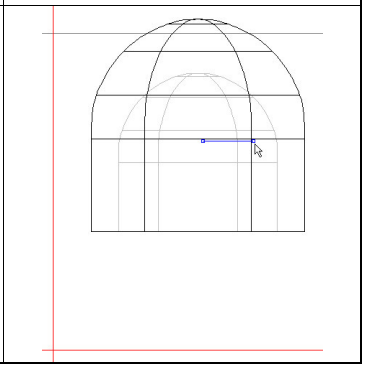
Hotkey	Hit [Shift + (←→↑↓)] keys to flip selected objects 90º

ROLL:

	Select objects (or CVs)
	Click on Roll button
	Click and drag to roll objects (or CVs) around world origin.

OBJECT AXIS:

When an object is created, the computer remembers where the Z-axis was. When Object Axis is turned on, the computer ignores the normal axes, instead reverting to the axes running through the object when the object was created.

Original Object (Z=Vertical)	Sizing with Object Axis off (World Origin)	Sizing with Object Axis on
		

COPY MENU

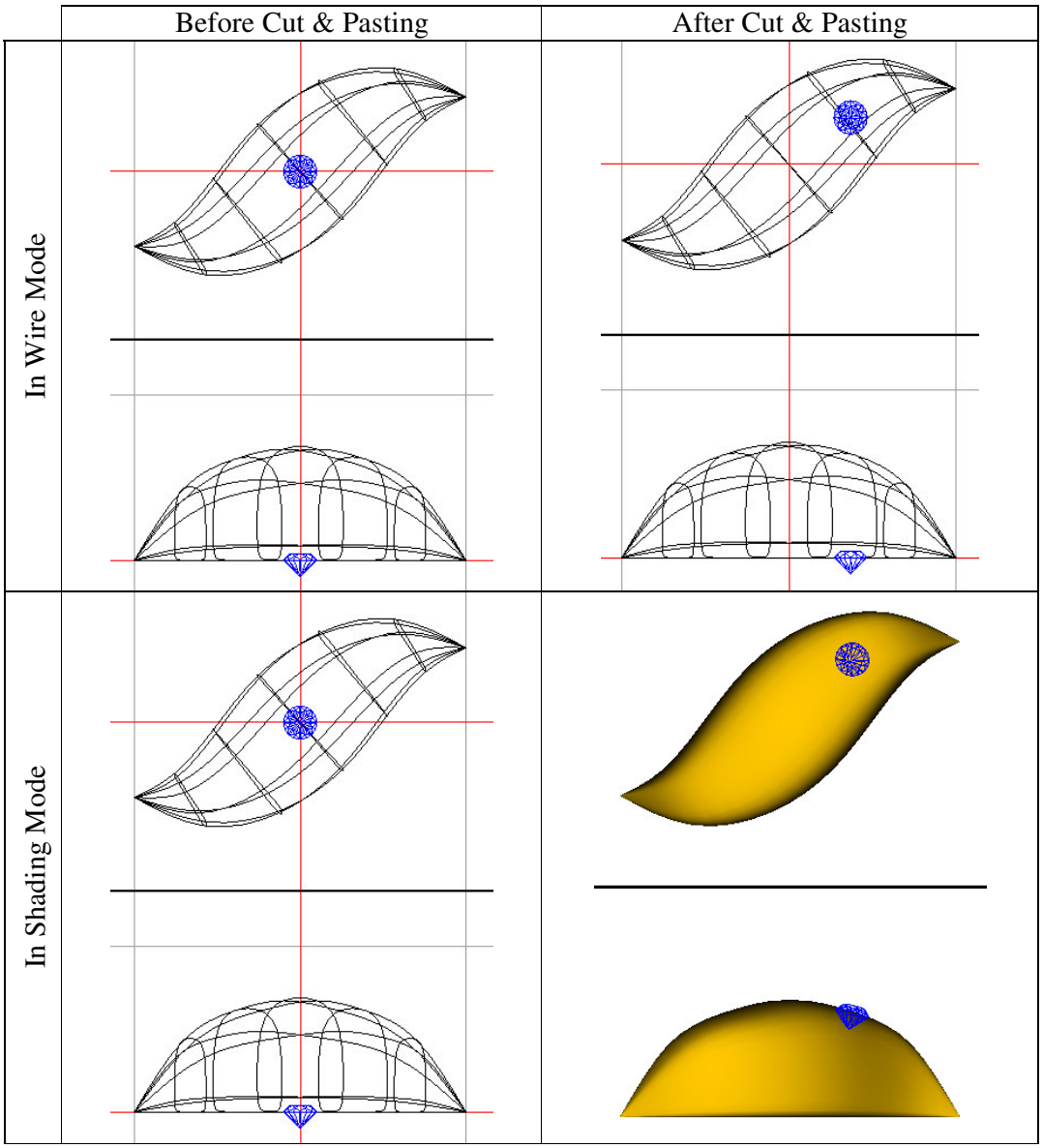
CUT & PASTE:

Cuts an object from the drawing and pastes it elsewhere

When pasting, if the view is in Wire frame, the pasted-object will be pasted in the same orientation as it was when cut.

If the view is in Shaded mode, the pasted-object can be pasted onto the shaded object, and remains 'normal' to the surface, whatever the contour.

Ie: The pasted-object should start at the world origin, (the position to which all database objects enter the view), then, if it is a gemstone, the girdle will be on the centre-line, and will 'sit on' the surface of the shaded object when pasted.



Objects can be adjusted after pasting which, for example, can be important for the position of grains in pave setting. But this can only be done with the last object pasted. The 'Undo' function can be used to rectify some mistakes.

To move a pasted object:

1. Hold Shift key down
2. Move curser over object.
3. Click and hold either left or right mouse button down and move

Note: Only works on the last object pasted.

To resize a pasted object:

1. Once pasted, hold Shift key down
2. Click Left Mouse Button
3. Drag towards/away from a centreline

Note: Only works on the last object pasted.

To rotate a pasted object:

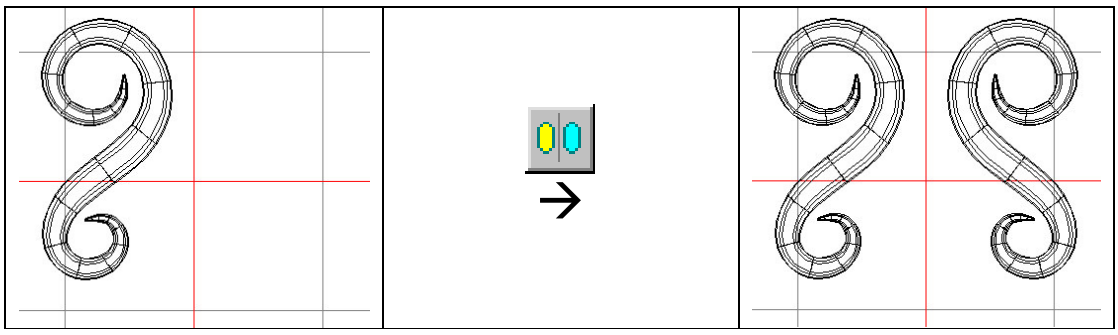
1. Once pasted, hold Shift key down
2. Hold down Right Mouse Button
3. Drag mouse to roll. Will roll around it's own axis.

Note: Only works on the last object pasted.

VERTICAL MIRROR COPY:

Mirrors objects across the Vertical Axis

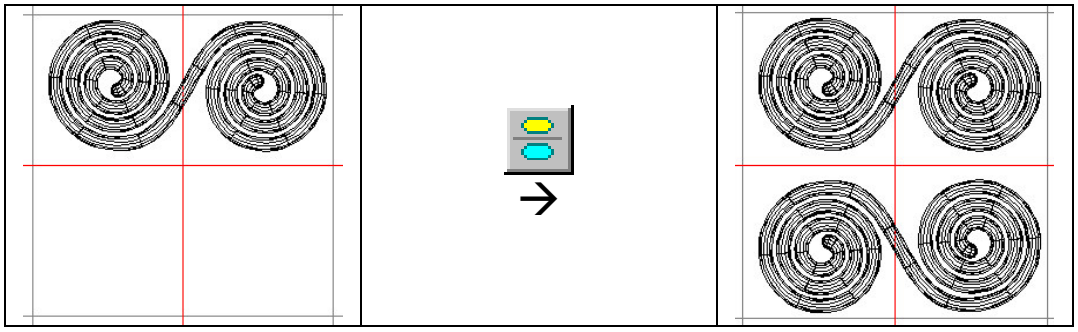
1. Select object to be copied
2. Click Vertical Mirror Copy button.



HORIZONTAL MIRROR COPY:

Mirrors objects across the Horizontal Axis

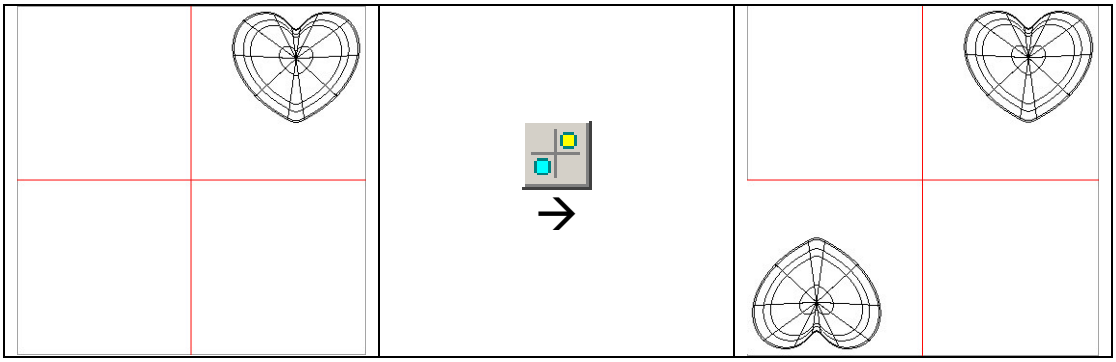
1. Select object to be copied
2. Click Horizontal Mirror Copy button.



REVOLVE 180º COPY:

Copies objects 180º around the origin

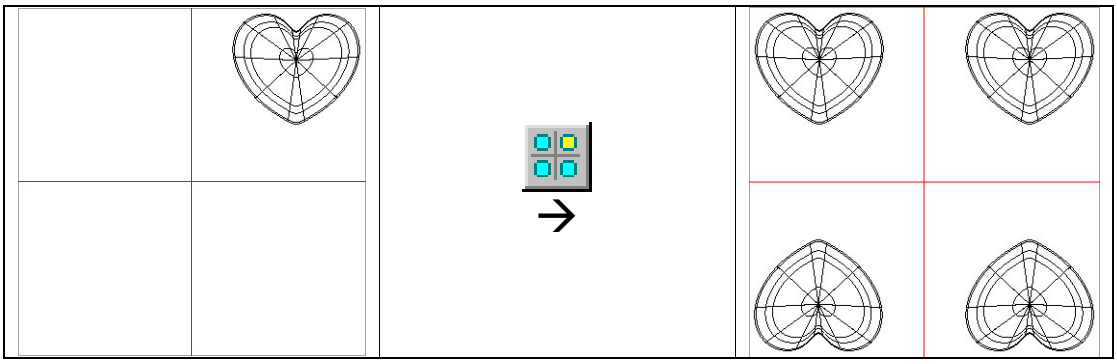
1. Select object to be copied
2. Click Revolve 180º Copy button.



CYCLE COPY:

Copies objects across Vertical and Horizontal Axes

1. Select object to be copied
2. Click Cycle Copy button.



EXTEND COPY:

Copy objects a set distance away, in a straight line.

No. to extend:
How many times to copy the objects. Includes the original.

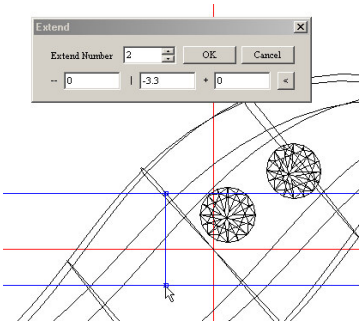
-- : (Horizontal):
The distance between copies, in the horizontal direction.(a minus number to move left)

| : (Vertical):
The distance between copies in the vertical direction. (a minus number to move down)

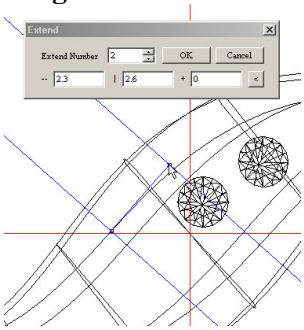
+ : (In/Out):
The distance between copies in the In/Out direction.

If you're not sure about the measurements, when the Extend Copy dialog box is open, hold the mouse button down on any point on the object and drag to where you want that point to be on the next object. Left Mouse Button will give you up/down or left/right coordinates. Right Mouse Button will give you up/down and left/right coordinates.

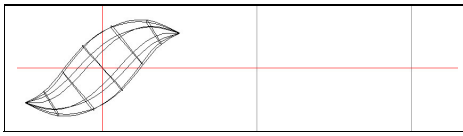
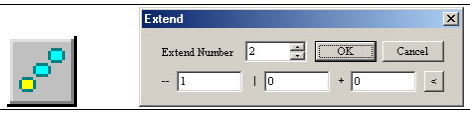
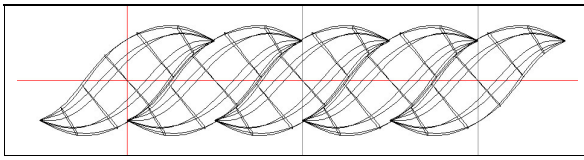
Left Mouse Button



Right Mouse Button



To Use:

	Select objects to copy
	Click "Extend Copy" button and change settings as necessary
	Click "OK"

REVOLVE COPY:

Copy objects in a circle, by a chosen angle

Number:
How many times to copy the objects. Includes the first.

Degree:
The angle between the objects

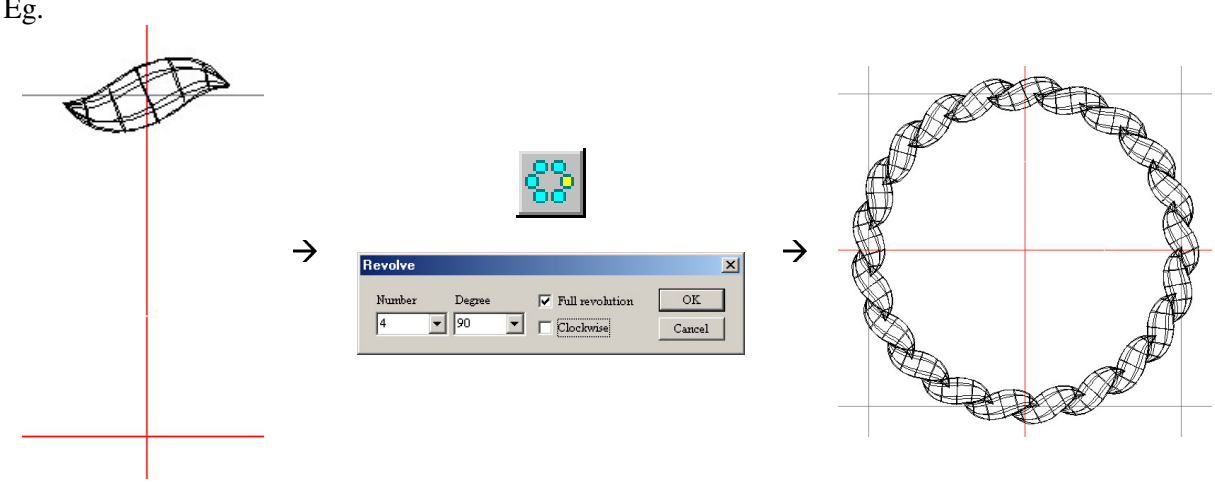
Full Revolution:
When checked, this function recalculates either the Number or Degree to equal 360º when the other is altered.

Clockwise:
Copies the objects in a clockwise direction.

To Use:

1. Select object(s) to be copied.
2. Click on "Revolve Copy" button.
3. Change settings, as necessary.
4. Click OK

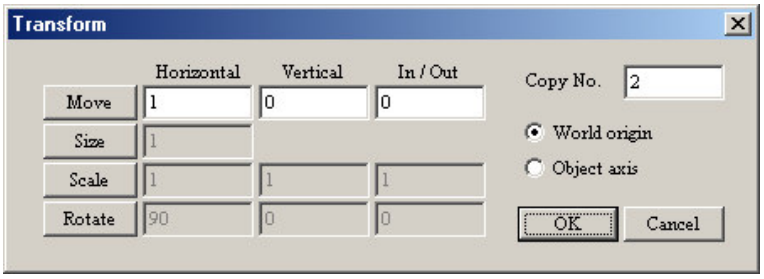
Eg.



If you're not sure about the measurements, when the Revolve Copy dialog box is open, hold the mouse button down on any point on the object and drag to where you want that point to be on the next object. You will notice a set of radii showing. These are the angles the objects will be copied by. Choose the one that is closest to the degree you want.

TRANSFORM COPY:

Copy objects according to the Transform Functions. Click on a function to activate.



Move:
Moves the object the distance specified along each axis

Size:
Resizes the object in all axes in proportion, by this MULTIPLYER

Scale:
Resizes the object along each axis separately by the MULTIPLYER in each box

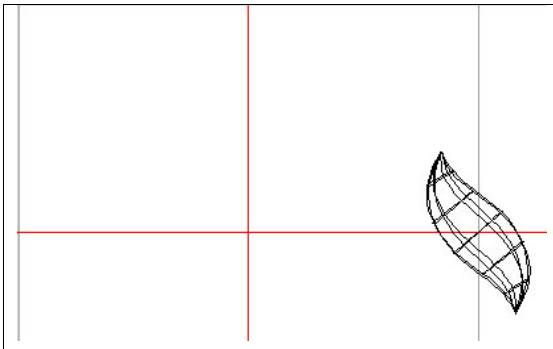
Rotate:
Rotates the object ARROUND the axis in which the angle is typed.

World Origin:
Use the World Origin as the reference point for the functions.

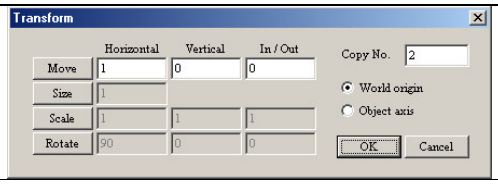
Object Axis:
Use the Object Axis as the reference point for the functions.

Copy No:
The number of times an object gets copied.

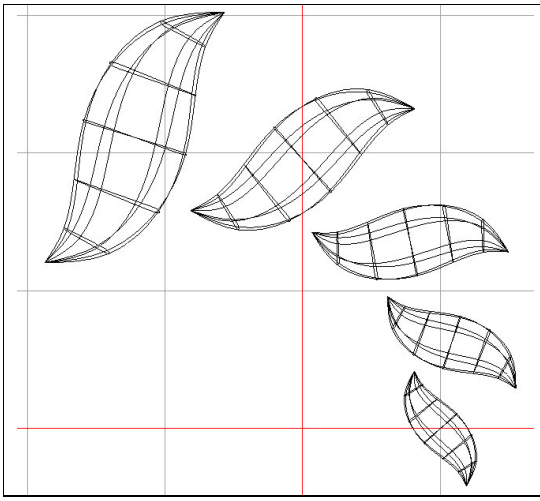
To Use:



Select object to be copied



Copy > Transform
Change settings as required.
This example uses: Size + Rotate
Size= 1.25 Rotate= 30º
Copies= 5



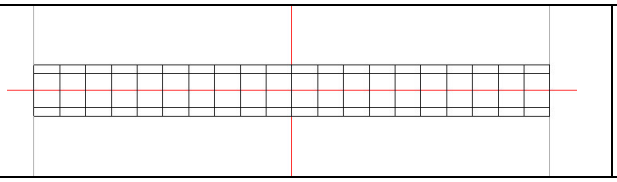
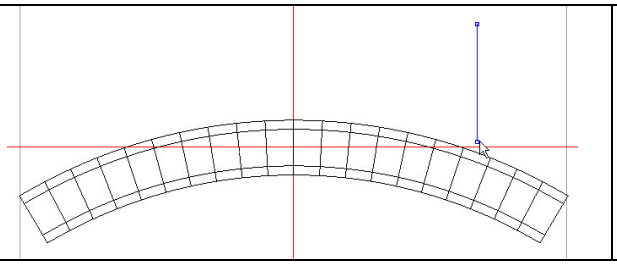
Click "OK"

DEFORM MENU:

BEND:

Bends objects around the World Origin

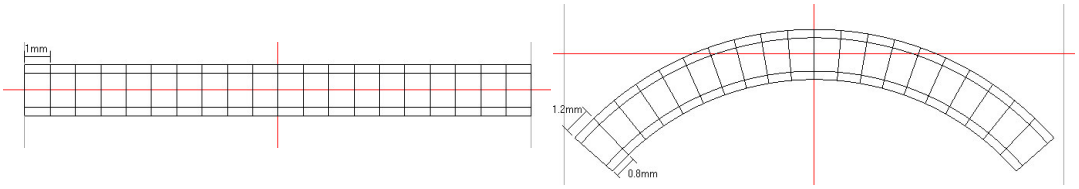
To Use:

	Select object, (or CVs)
	Click on Bend Button
	Click and hold left mouse button down and drag in the direction to be bent.

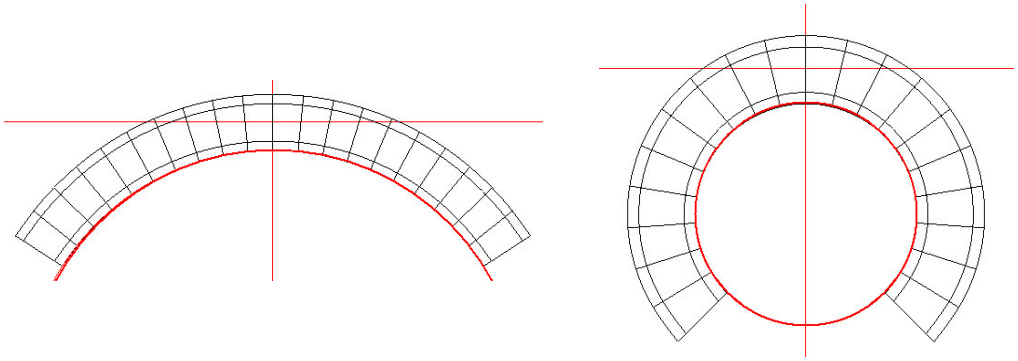
When bending, the following rules must be recognised:

1. Any part "above" the centreline will be stretched in length
2. Any part on the centreline will remain the same length
3. Any part "below" the centreline will be compressed in length

Ie.



The curve made by bending is part of a circle. As you bend further, the circle diameter becomes smaller. If you bend far enough, the end of the object will meet up as a circle.

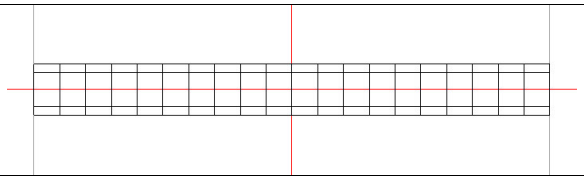
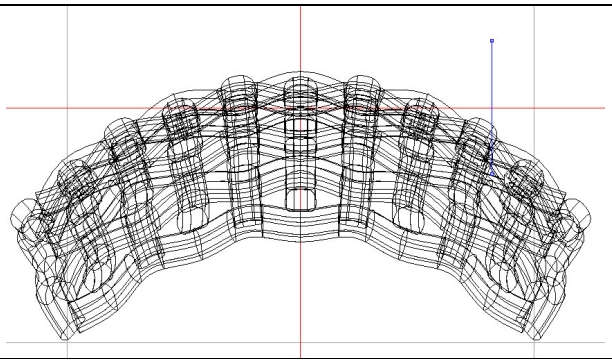


To get the desired affect, it may be necessary to move the object before bending

BEND (2 Sides)

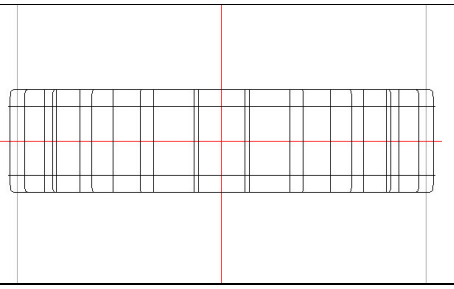
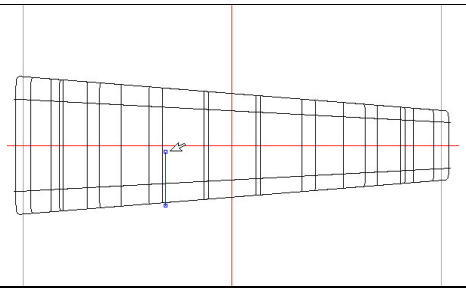
Bends objects in two directions (domes object)

To Use:

	Select object, (or CVs).
	Click on Bend (2 Sides) button
	Click and hold left mouse button down and drag in the direction to be bent.

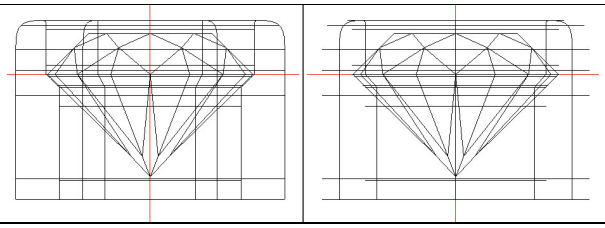
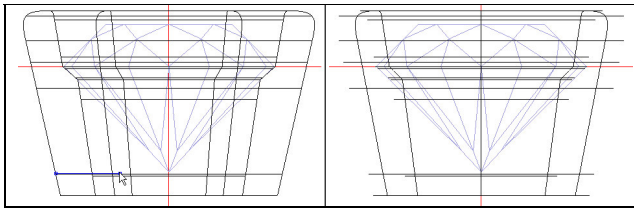
TAPER

Tapers an object, pivoting on the centreline

	Select object, (or CVs)
	Click on Taper button
	Click and hold left mouse button down and drag across the screen. Object will taper into/out in that direction

TAPER (2 SIDES):

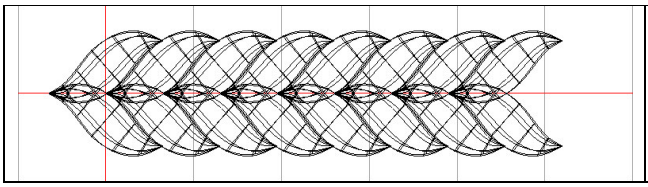
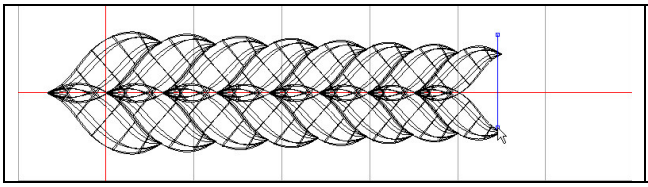
Tapers an object in two directions, pivoting on the centreline

	Select object, (or CVs)
	Click on Taper (2 Sides) button
	Click and hold left mouse button down and drag across the screen. Object will taper into/out in that direction

SCALED TAPER:

Tapers an object and resizes to keep proportions

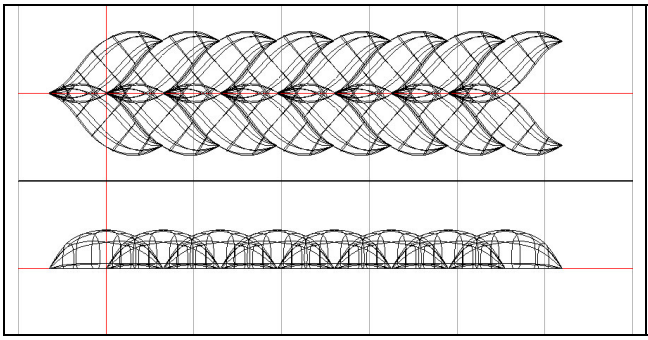
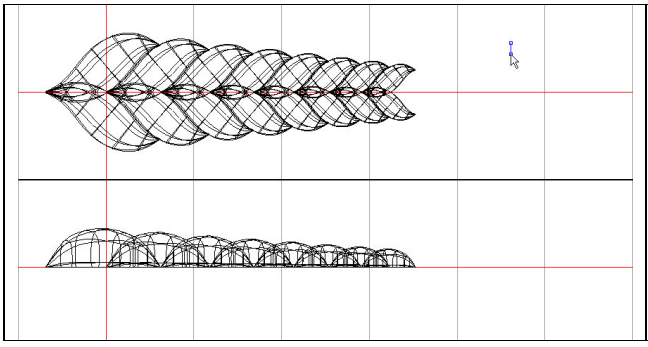
To Use:

	Select object, (or CVs)
	Click on Scaled Taper button
	Click and hold left mouse button down and drag across the screen. Object will Scale-Taper into/out in that direction

SCALED TAPER (2 SIDES):

Tapers and object and resizes proportionately in two directions

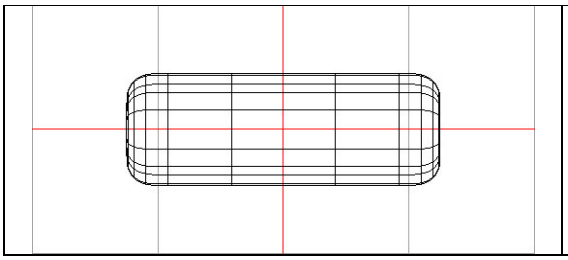
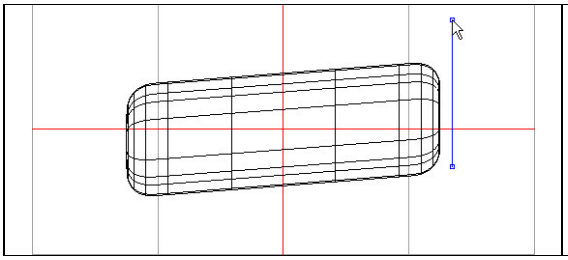
To Use:

	Select object, (or CVs)
	Click on Scaled Taper button
	Click and hold left mouse button down and drag across the screen. Object will Scale-Taper into/out in that direction

SKEW: (LOZENGE)

Skews an object parallel to and pivoting on an axis

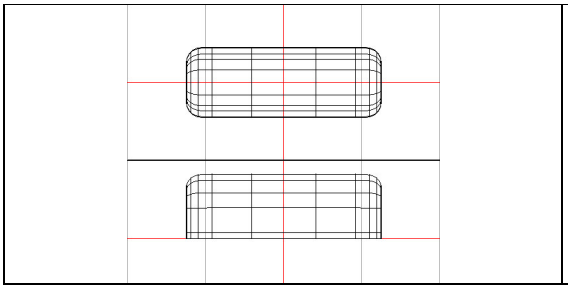
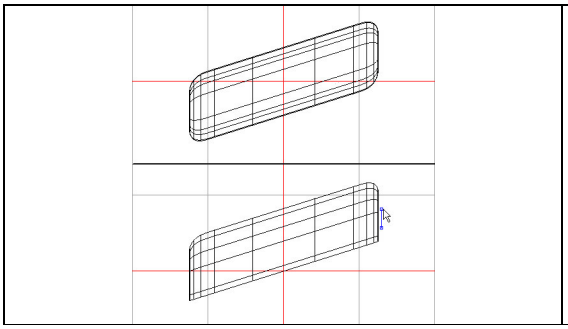
To Use:

	Select object, (or CVs)
	Click on Skew button
	Click and hold left mouse button down and drag across the screen. Object will Skew (lozenge) parallel to mouse movement.

SKEW (2 SIDES):

Skews an object parallel to and pivoting on an axis, in two directions

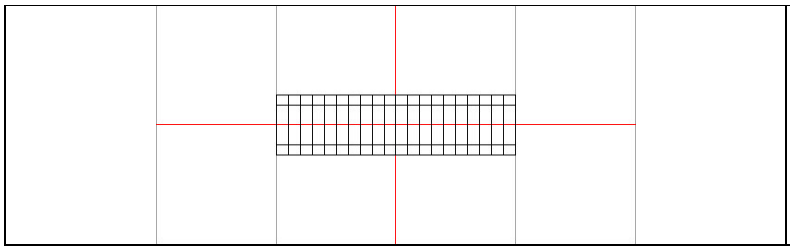
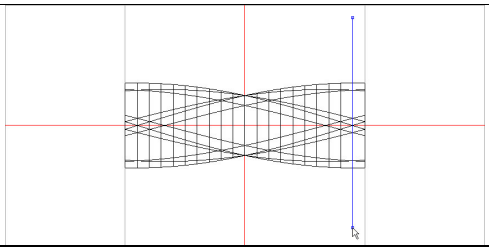
To Use:

	Select object, (or CVs)
	Click on Skew (2 Sides) button
	Click and hold left mouse button down and drag across the screen. Object will Skew parallel to mouse movement

TWIST:

Twists an object around an axis

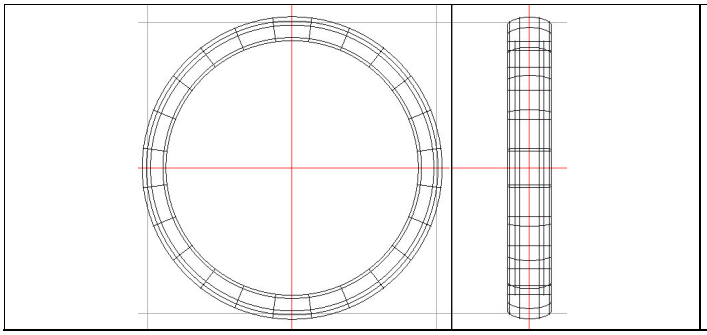
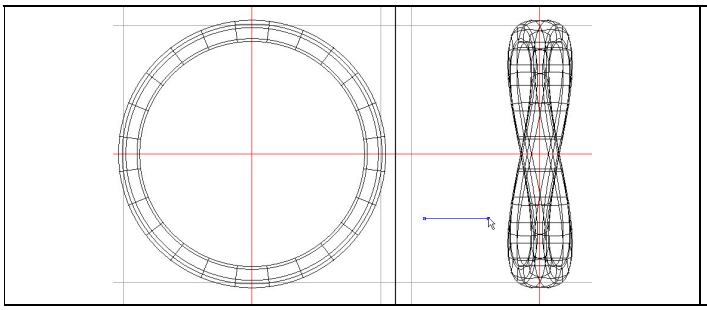
To Use:

	Select object, (or CVs)
	Click on Twist button
	Click and hold left mouse button down and drag across the axis to twist around

SKEW-TWIST:

Combines Skew and Twist
Objects appear twisted from one side, but remain the same from the other.

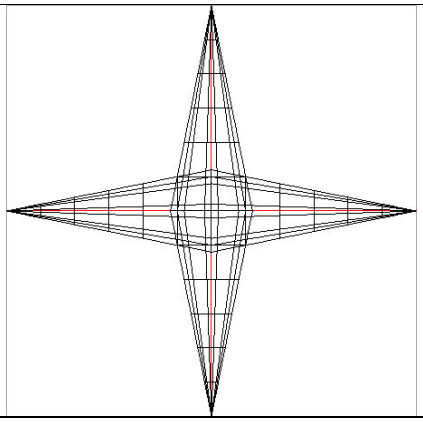
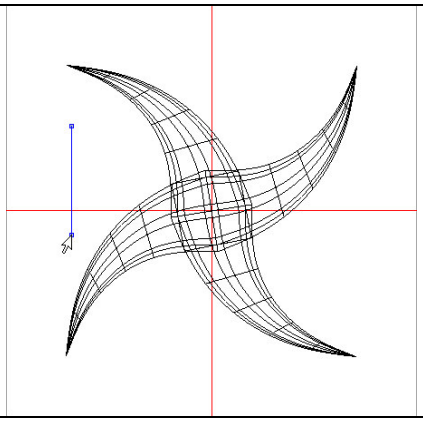
To Use:

	Select object, (or CVs)
	Click on Skew-Twist button
	Click and hold left mouse button down and drag across the axis to Skew-Twist around

WHIRL:

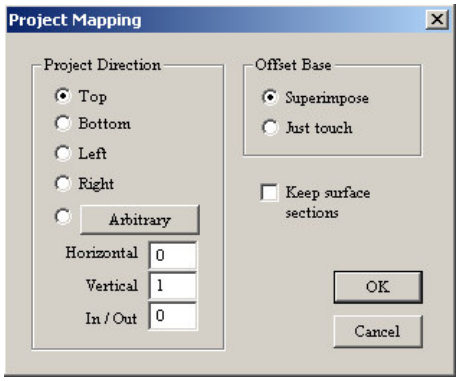
Rotates object around the World Origin
The further the point is from the World Origin, the further it is rotated

To Use:

	Select object, (or CVs)
	Click on Whirl button
	Click and hold left mouse button down and drag across screen.

PROJECTION-MAP:

Projects objects/CVs onto another surface/curve, in a straight line



Project Direction:

Top:
Project onto the Top of the object

Bottom:
Project onto the Bottom of the object

Left:
Project onto the Left side of the object

Right:
Project onto the Right side of the object

Arbitrary:
Project in a user-defined direction

Offset Base:

Superimpose: Projects the object so it is the same distance from the surface/curve as it was from the axis. The projected object is deformed to suit the curvature of the second object, unless defined as nondeformable., as in gemstones.

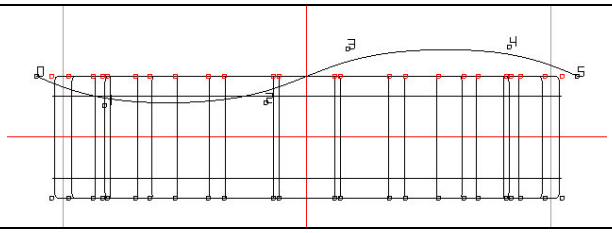
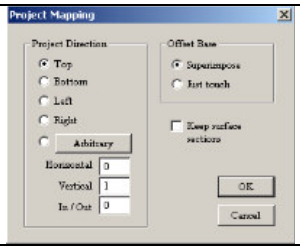
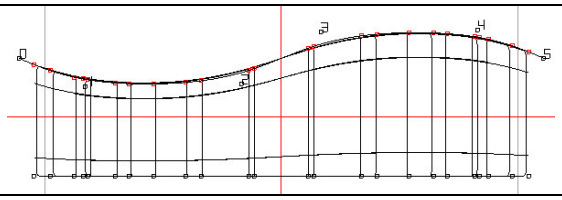
Just Touch: Projects everything that is selected, so it sits on the line. Used mostly on CV's to change the sh ape of an object.

Keep Surface Sections:

Preserves the shape of the Surface Section after projecting

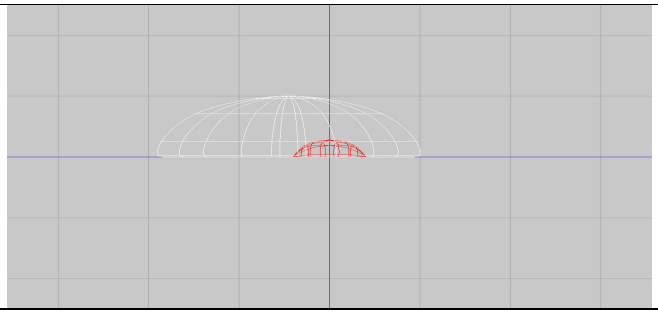
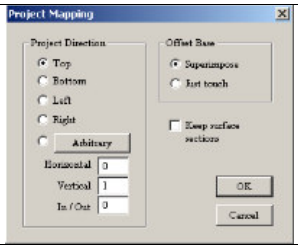
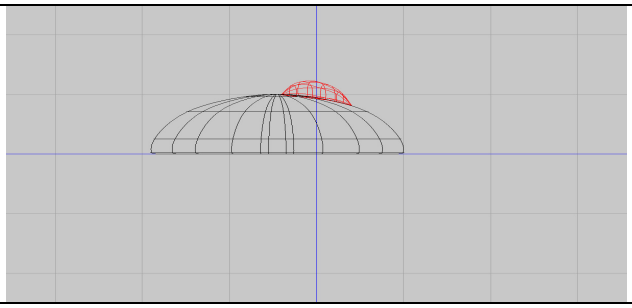
The 'just touch' function

To Use:

	Select object CVs to be projected
	Click on ProjMap button
	Change settings to 'just touch'> 'OK"
	Click on object to project onto

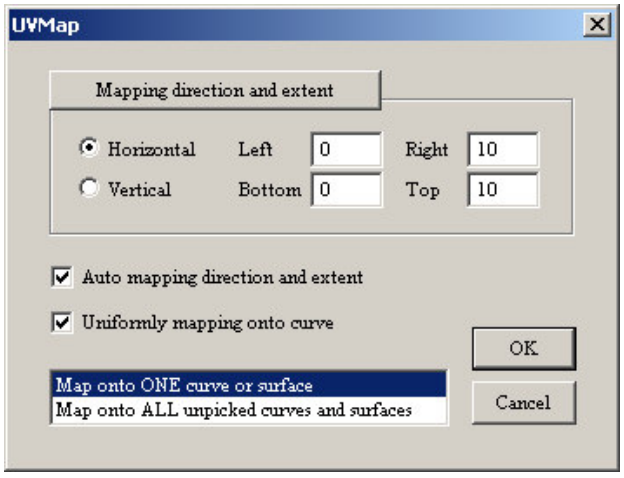
The ‘superimpose’ function

To Use:

	Select object to be projected
	Click on ProjMap button
	Change settings to ‘top’ and ‘superimpose’ ‘OK’
	Click on object to project onto

UV MAP:

Maps objects onto a curve or surface. Will stretch/compress objects to fit.



Mapping Direction and Extent:

Direction: The direction of the object used to map onto the curve/surface.

Extent: The area to be mapped onto the curve/surface. The contents of this box are stretched/compressed to fit over the entire surface/curve.

Auto Mapping Direction and Extent:

Checked: Ignores user-defined mapping and extent settings and calculates them for itself.

Unchecked: Uses user-defined settings. (See above)

Uniformly mapping onto curve:

When checked, distributes objects evenly over the surface/curve.

When not checked, will distribute objects according to density of CVs.

More CVs = more objects

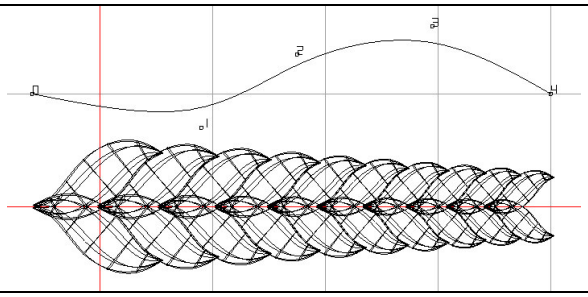
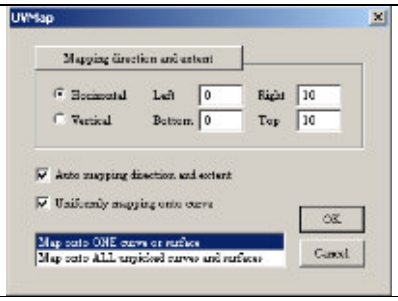
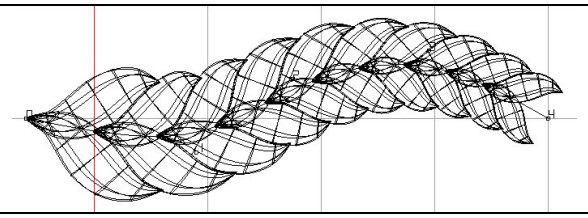
Map onto ONE curve or surface:

Maps only onto the one curve/surface the user selects

Map onto ALL unpicked curves or surfaces:

Maps objects onto all unpicked curves or surfaces. Makes copies as necessary.

To Use: Mapping to a Curve

	Select object/CVs to be mapped
	Click on UVMap button
	Use default, (automatic) settings "OK"
	Click on curve to map onto

CURVE Menu

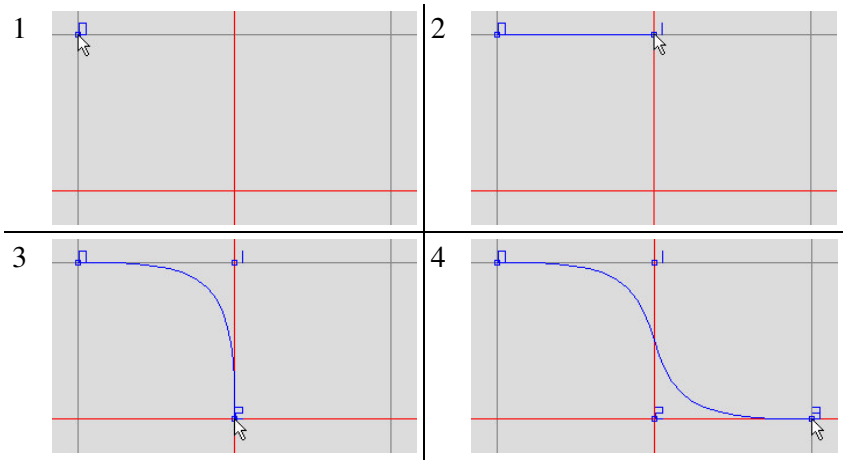
There are a few ways of drawing a curve in JewelCAD, depending on what you want the finished curve to look like.

A curve is drawn by pressing the Left Mouse Button where you want a new point to be. If this is not possible, you can create the new point somewhere else and drag it over to where you want it. Points can be added at the beginning of a curve, at the end, or between two existing points. As the points affect the shape of the curve, you can alter the points to change the curve to what you want.
ie: adding a point to pull the curve in one direction.

Every point in a curve is numbered, starting at '0', and therefore the curve has a direction with CV number '0' being the start point. This is used to determine 'left' and 'right' cur ves when using rail functions.

Operation	Mouse Button Used
Create new point	Left Mouse Button. Just click.
Move an existing point	Left Mouse Button. Hold Down over CV and drag to new position.
Delete point	Left Mouse Button held down, then click Right Mouse Button.
Start a new curve	In a drawing mode, hold Ctrl Key down. Click Left Mouse Button to begin new curve.
Edit an existing curve	In a drawing mode, hold Shift Key down. Click Left Mouse Button on existing curve.
Make a curve sharper at a point (Multiple CV)	Left Mouse Button, double-click on CV.

HOW TO:

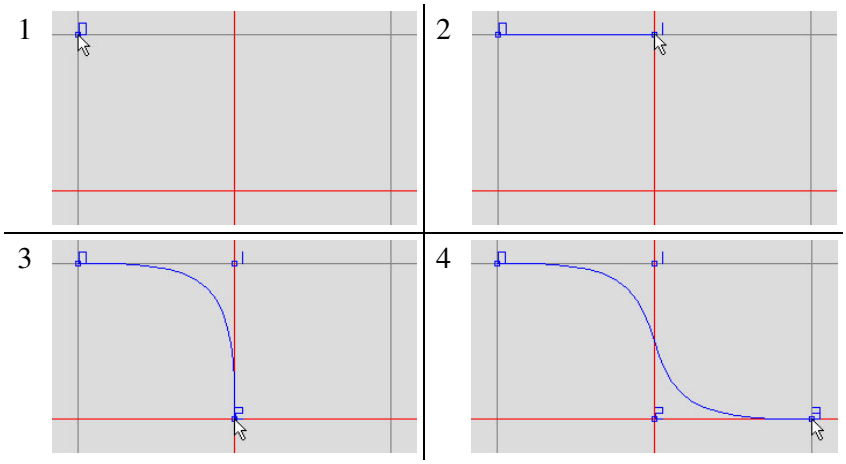


TYPES OF CURVES:

SIMPLE CURVE:

Draws a curve point-by-point. Good for non-symmetrical curves.

1. Click on "Simple Curve" Button to enter the "Simple Curve" drawing mode.
2. Click in the screen to begin the curve. Continue clicking to add points.

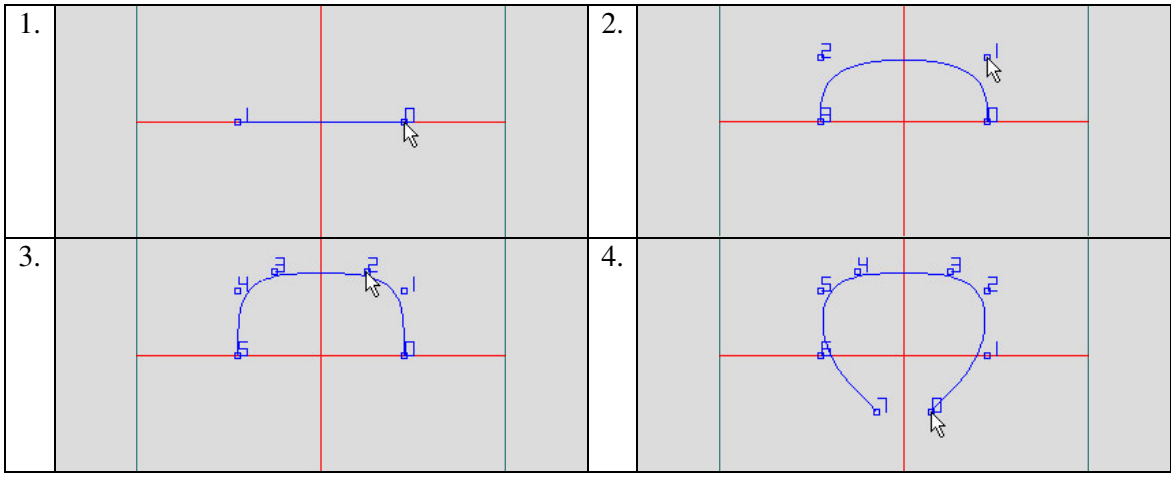


VERTICAL MIRROR CURVE:

Draws a curve, mirrored across the vertical axis.

1. Click on "Vertical Mirror Curve" Button to enter the drawing mode.

2. Click on one side of the centre-line and see the point mirrored across the centreline. Continue clicking to add points.

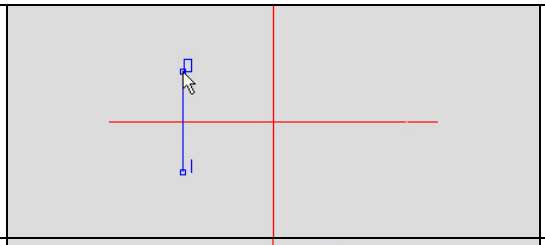
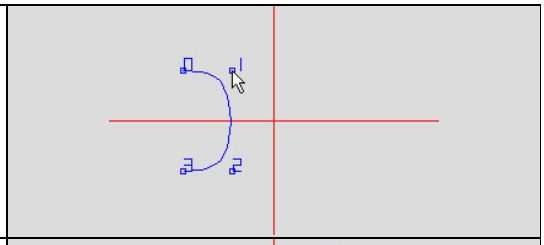
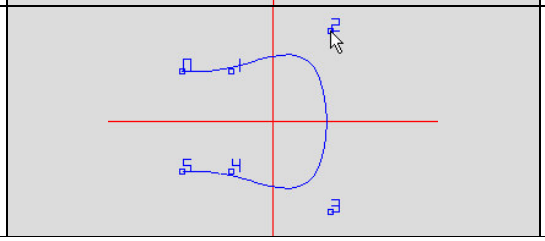
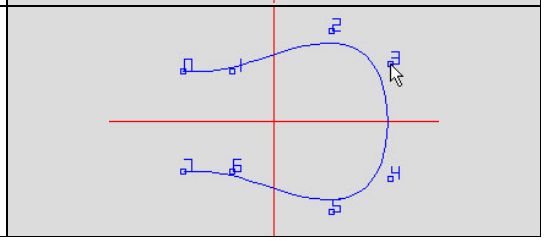


HORIZONTAL MIRROR CURVE:

Draws a curve, mirrored across the horizontal axis.

1. Click on "Horizontal Mirror Curve" Button to enter the drawing mode.

2. Click above or below the centre-line and see the point mirrored across the centreline. Continue clicking to add points.

1. 	2. 
3. 	4. 

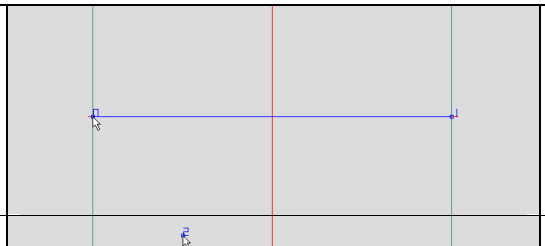
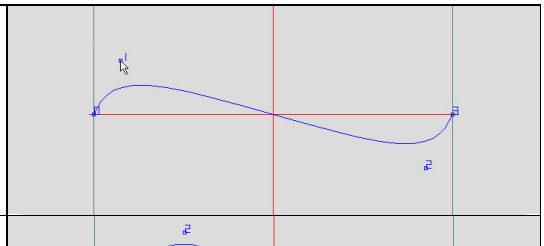
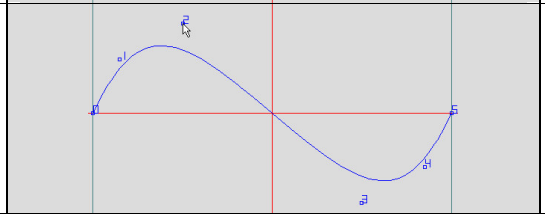
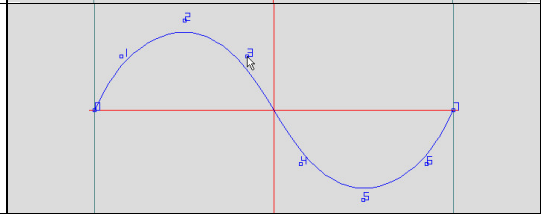
REVOLVE 180º CURVE

Copies points, 180º rotated from each other.

1. Click on "Revolve 180º Curve" button to enter drawing mode.

2. Click in screen. Each point you draw will be rotated 180º around the centre-point.

N.B. The line will ALWAYS go through the centre-point.

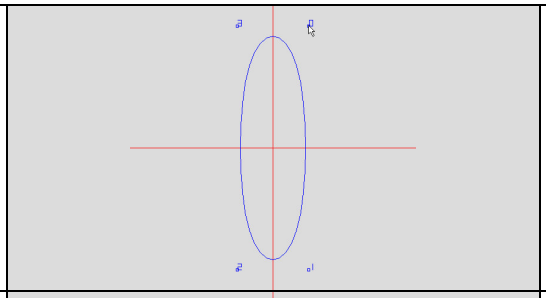
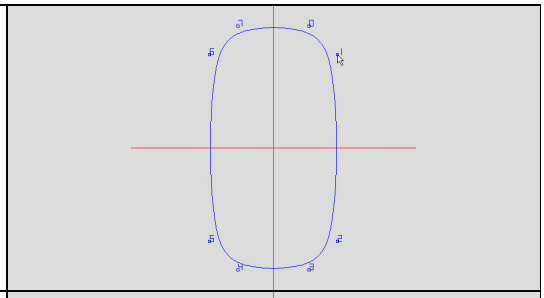
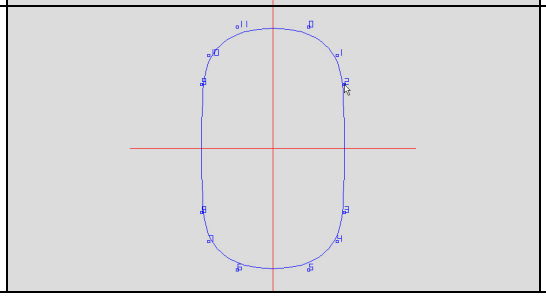
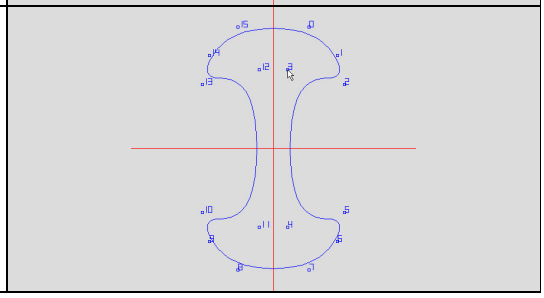
1. 	2. 
3. 	4. 

CYCLE CURVE:

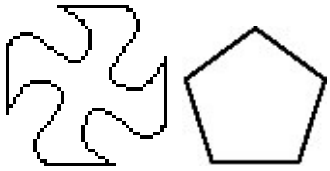
Points are mirrored across both axes.

1. Click on "Cycle Curve" Button to enter drawing mode.

2. Click in screen. The point you draw will be mirrored across the vertical axis and across the horizontal axis.

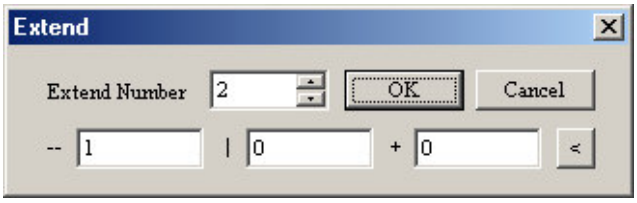
1.		2.	
3.		4.	

Exercises:



EXTEND CURVE:

Creates a curve which is repeated a chosen number of times, at a chosen distance.



No. to extend:
How many times to copy the points. Includes the first point.

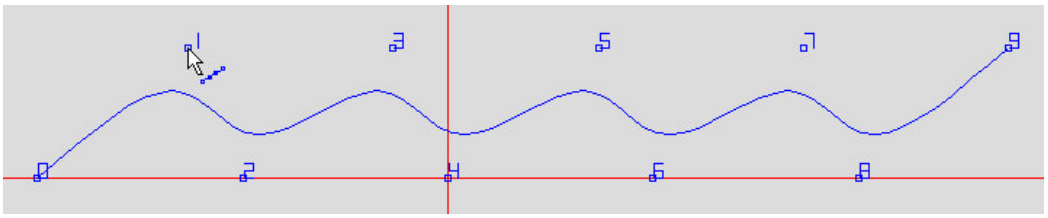
--(Horizontal):
The distance to copy, between points, in a horizontal direction.

| (Vertical):
The distance to copy, between points, in a vertical direction.

+ (In/Out):
The distance to copy, between points, in an in/out direction.

To Use:

1. Click on "Extend Curve" button.
2. Change settings, as necessary.
3. Click OK
4. Click in screen. Every point drawn will be copied according to the settings.
5. The position of the points can be adjusted by 'dragging' with the mouse.

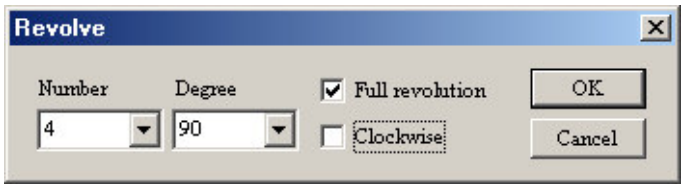


The above drawing was drawn with the following settings:
No. to extend: 5
Horizontal: 3
Vertical: 0
In/Out: 0

Exercises:

REVOLVE CURVE:

Copies points by a set degree, in a circle



Number:
The number of times to copy. Included the first point.

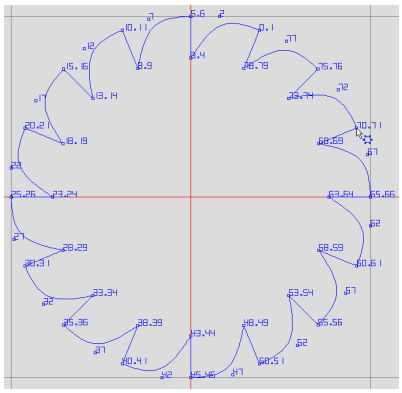
Degree:
The angle separating the copies.

Full Revolution:
If this is selected when either the number or degree is changed, the computer will calculate the other to equal 360º.

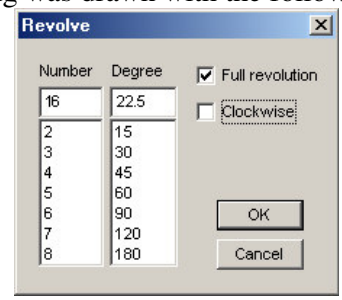
Clockwise:
Copies points in a clock-wise direction.

TO USE:

1. Click on "Revolve Curve" Button to enter drawing mode.
2. Change settings as necessary.
3. Click OK
4. Click in screen to begin drawing.

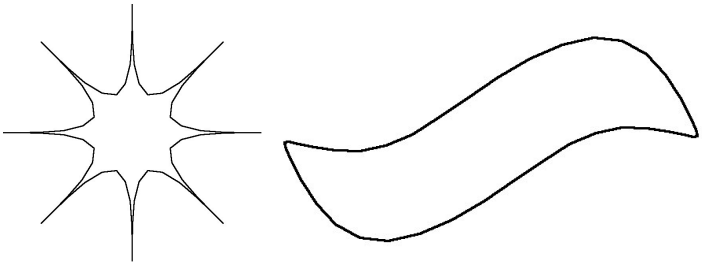


This drawing was drawn with the following settings:



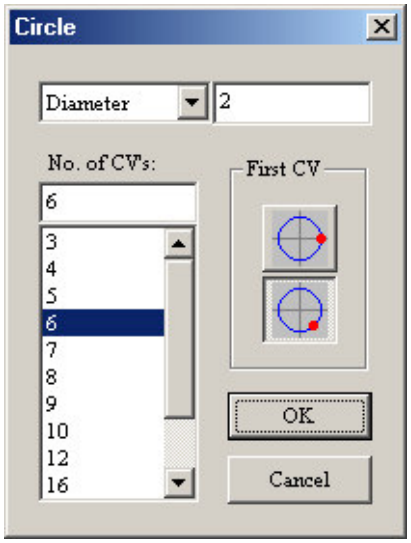
Therefore, there are:
16 copies, separated by 22.5º (16 x 22.5 = 360º)

Exercises:



CIRCLE:

Draws a circle



Diameter/Radius: Determines what dimension is being used. The measurement is typed in the box beside.

No. of CV's:
Sets how many CV's make up the circle. The more CV's, the smoother the curve.

First CV:

Puts the "0" CV on the right -hand side, on the horizontal axis.

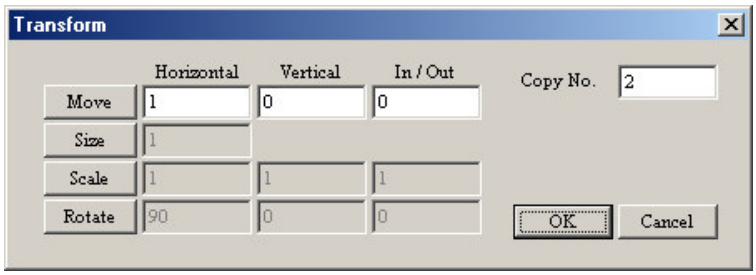
Puts the "0" CV on the right -hand side, at 45 degree angle

To Use:

1. Click on "Circle" button.
2. Change settings as necessary
3. Click OK

TRANSFORM CURVE:

Draws a curve by copying CVs according to the Transform functions



Move:

Moves the object the distance specified along each axis

Size:

Resizes the object in all axes in proportion, by this MULTIPLYER

Scale:

Resizes the object along each axis separately by the MULTIPLYER in each box

Rotate:

Rotates the object ARROUND the axis in which the angle is typed.

Copy No.:

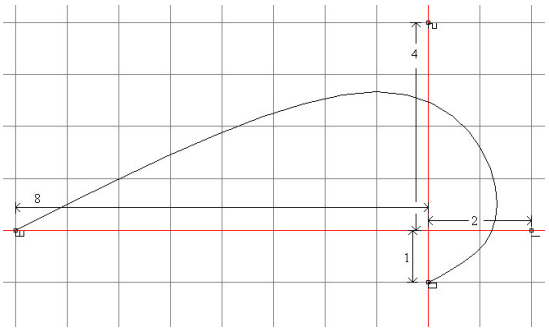
The number of times a point gets copied. If there are 2, the function will not have much effect.

Combining Functions:

To combine functions (eg roll 30º move up 10mm and resize x2 all at once), click on the relevant function buttons and alter the numbers as required. To work with just one, click function button until other buttons deactivate.

To Use:

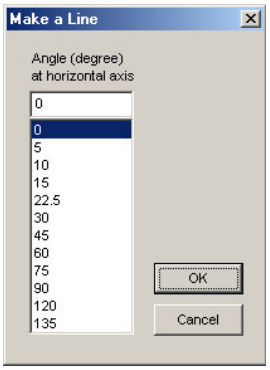
1. Click on "Curve" menu, then on "Transform"
2. Change settings as necessary
3. Click OK
4. Click once in screen. Curve will be drawn from that point, as per your settings.



This drawing was drawn with the following settings:
Size + Rotate, Size: 2, Rotate: In/Out 90º

Point "0" is 1mm from the centre, point "2" is 2mm (1mm x 2), point "3" is 4mm (2mm x 2), point "4" is 8mm (4mm x 2). Each is rotated 90º from the previous.

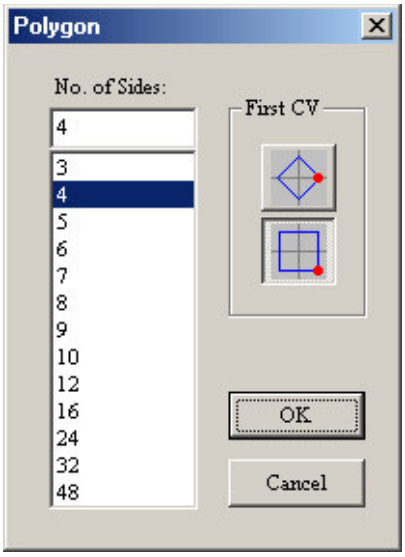
LINE:



Draws a 2mm long line, at a given angle.

1. Select "Line" from Curve Menu.
2. Specify degree, either by selecting one of the pre-sets or by typing it in
3. Click ok

POLYGON:



Draws a polygon, with a diameter of 2mm.

1. Select "Polygon" from Curve Menu.
2. Chose number of sides in the polygon
3. Click "OK"

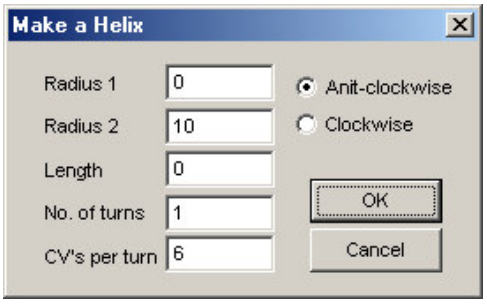
No. of Sides:
The number of sides on the polygon

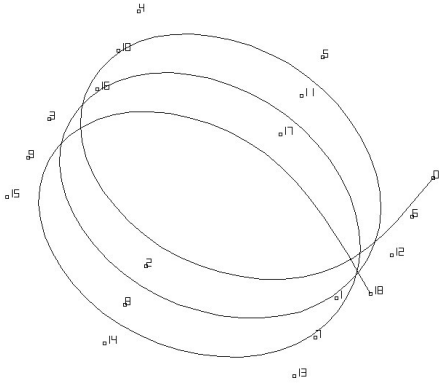
First CV:

Puts the "0" CV on the right -hand side, on the horizontal axis.

Puts the "0" CV on the right -hand side, at 45 degree angle.

HELIX:





Draws a helix, according to given settings

Radius 1:
The radius at the beginning of the helix
Radius 2:
The radius at the end of the helix
Length:
The overall length of the helix
No. of Turns:
The number of turns in the helix
CV's per Turn:
The number of CVs per turn of the helix
Anti-Clockwise/Clockwise:
The direction the helix flows in.

1. Select "Helix" from the Curve Menu.
2. Change settings as required.
3. Click "OK"

MORE CURVE OPERATIONS:

ADJUST:

Edit an existing curve as if it was Simple, Vert. Mirrored etc.

CLOSE CURVE:

Joins the start- and end-points together, making the curve into a loop.

OPEN CURVE:

Un-joins the start- and end-points.

SKETCH:

Allows you to draw a freehand curve. The curve is then converted to have CVs etc.

REVERSE:

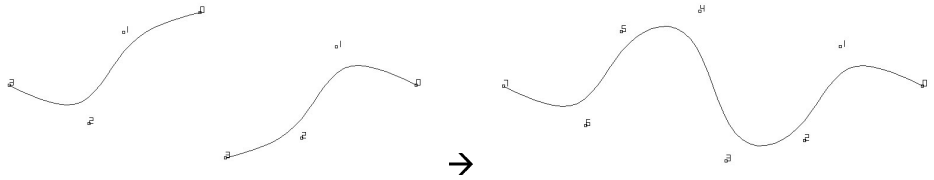
Reverses the order of CV's on the curve.

DIVIDE CURVE:

Multiplies the number of CV's on a curve by a factor, without changing the shape.

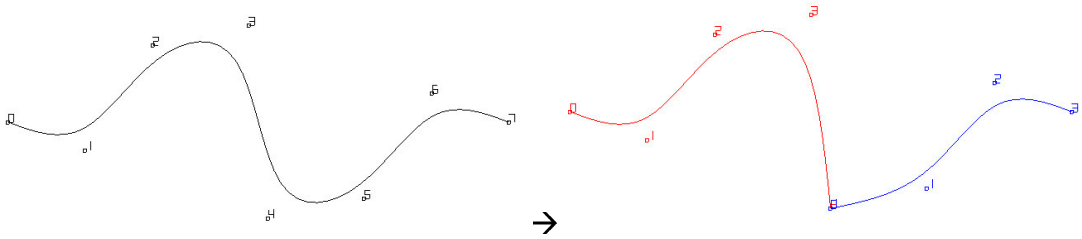
JOIN CURVE:

Joins two curves together into one. After this operation is selected, the curves need to be selected. The program will join the curves together from the end of one to the start of another:



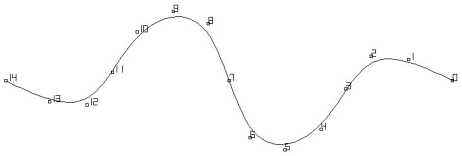
SPLIT CURVE:

Will split a curve at a CV. The CV will then become the end of one curve and the start of the other.

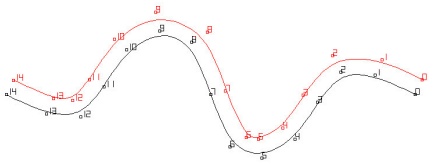


OFFSET CURVE:

Creates a curve a set distance off another.



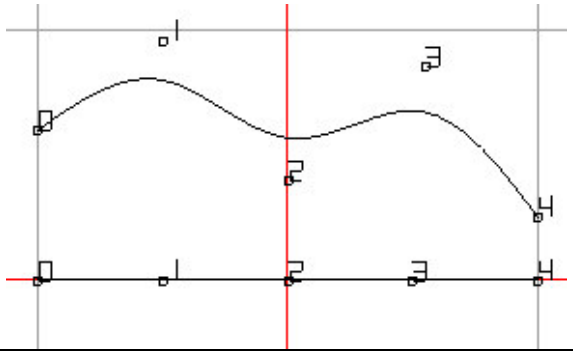
Original Curve



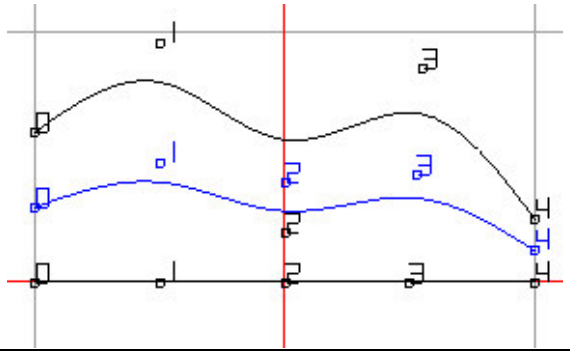
After offsetting 1mm

IN BETWEEN CURVE:

Creates a curve half-way between two others



Original Curves



With Curve In Between

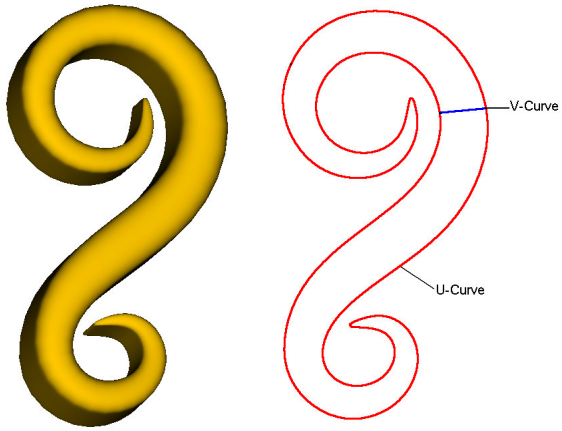
Original curves **MUST** have the same number of CVs before creating a curve In Between

CURVE LENGTH:

Measures the length of a curve

SURFACE MENU

JewelCad refers to 3D objects as 'surfaces', because it is a 'Surface Modeller'. However, this manual uses the expressions:- Surface; 3D object: and object, and all can be interpreted as the same thing.
3D Object are constructed from least, two shapes: one being a cross-section and the other being the shape, (or 'profile'), of the object itself. In JewelCAD, the cross -section curve is called the "V -Curve" and the shape, (profile), curve is called the "U -Curve".



At least, two curves must be used to create a surface. JewelCAD sometimes has a pre-set shape as part of the function, so you only have to draw one curve. In other functions, you must draw ALL curves.
UNLIKE OTHER 3D PROGRAMMES, THE PROFILE AND SECTION ARE DRAWN ON THE SAME VIEW (PLANE), AND THE ORIENTATION FIXED BY A TABLE,(called 'surface extent') WHEN CARRYING OUT THE SURFACE FUNCTIONS.
Depending on which curves you can draw; you can use one of five surfacing functions:

Extend Surface:

Creates an object, extruded from a cross-section curve. U-Curves will be straight lines. The cross section curve must be closed.

Horizontal/Vertical Revolve Surface:

Revolves a closed cross-section curve around the vertical or horizontal axis, to create a circular object. (eg. A plain finger ring)

Loft Surface:

Joins 2 or more closed cross-section curves to create an object.

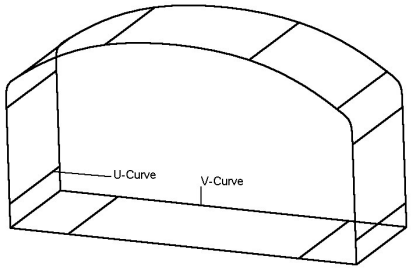
Pipe Surface:

Sweeps a closed cross-section curve along a single curve.

Rail Surface:

Where the boundaries of the shape, (profile), are drawn as curves and the cross-section is put between these curves.

EXTEND SURFACE:



Extrudes an object from a curve

The function works by copying the section curve, so that there are 2 or more, and then 'filling in' between them

Extend Number:

The number of sections (including the original). Must be no less than 2.

-- (Horizontal) / | (Vertical) / + (In/Out):

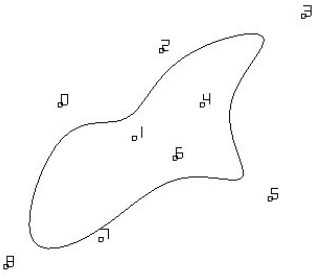
The direction(s) in which to extrude the curve. The measurement is between the cross-sections, not overall. Directions are from the current View.

Horizontal: Across the screen. Left is negative, right is positive
Vertical: Up and down the screen. Up is positive, down is negative
In/Out: Towards and away-from you. Towards in positive, away from you is negative.

Changes the functions (Horiz, Vert, In/Out) to Length, Angle from Horizontal and Angle In/Out

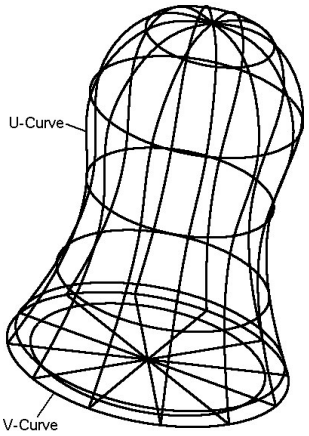
Length: Length of surface, at the angle
Angle at Horiz: Angle up from Horizontal axis, rotating around the In/Out axis.
Angle In/Out: Angle towards or away-from you. Rotates around the horizontal axis.

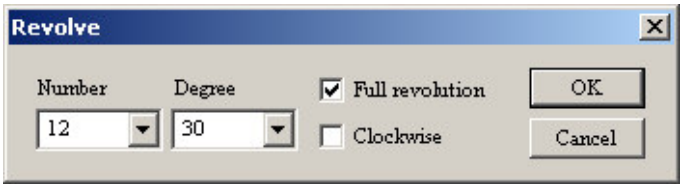
To Use:

	Draw cross-section, using a Curve function. Make sure the curve is selected (white) The section must be closed by :- 'curve'>'close'
	Click on Extend Surface button
	Change settings, as necessary Click "OK" If the length is unknown, use the mouse to 'drag' the length required on screen, and click OK

REVOLVE SURFACE

Revolves a surface from a curve, around the vertical or horizontal axis





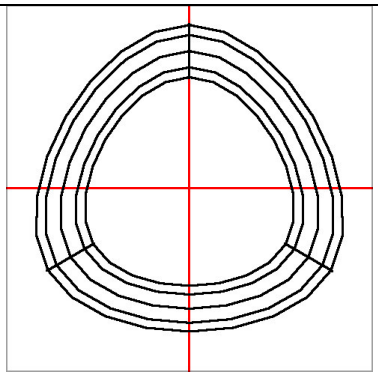
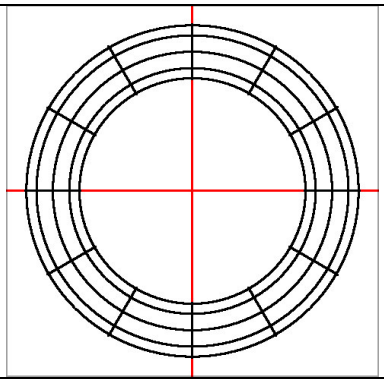
Number: The number of times the cross-section is repeated around the surface.

Degree: The angle separating the cross-sections

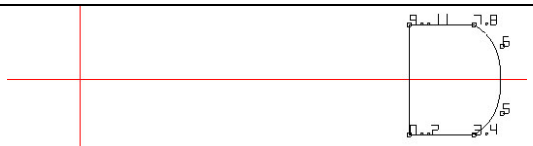
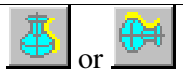
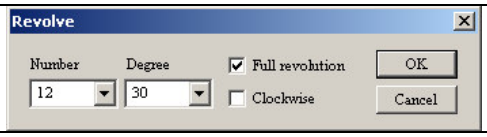
Full Revolution:
Automatically calculates the degree/number when one is typed in, so they equal 360º

Clockwise: Revolves the cross-section in a clockwise direction.

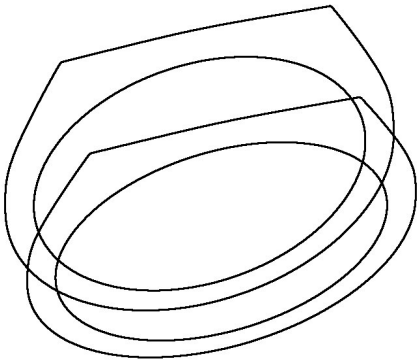
The effect of more/less cross-sections:

	
Three Cross-sections	12 Cross-sections

To Use:

	Draw cross-section using a Curve function. Make sure the curve is selected (white). The curve must be closed.
	Click one of the Revolve Surface buttons
	Change settings as required. Click "OK"

LOFT SURFACE:



Joins curves/surfaces together to create a single surface

Reverse Section:

Reverses the direction of numbers on the cross-section. Only applies if Lofting curves.

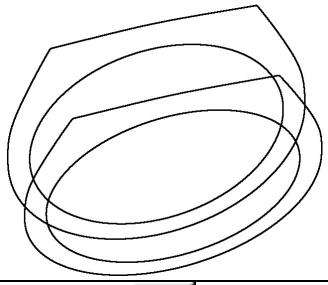
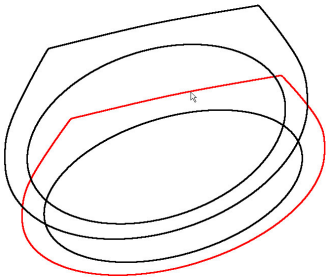
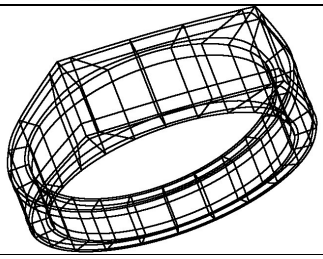
Reverse Surface:

Reverses the direction of numbers on the U-Curve of the surface that has just been selected. Only applies if Lofting surface.

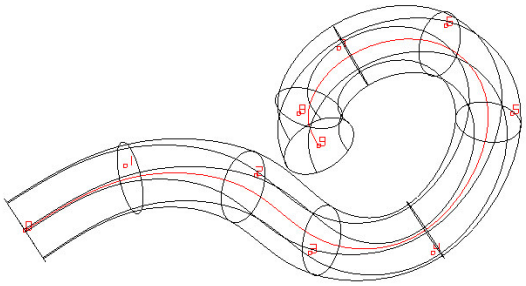
Swap UV:

Switches which curve is a U-Curve and which is a V-Curve in the surface that has just been selected.

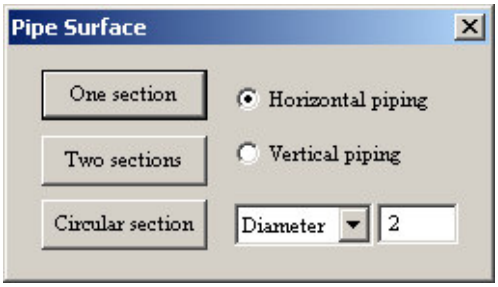
To Use:

	Draw cross-sections to join. Curves must be closed.
	Click on Loft Surface button
	Click each curve in turn, clicking 2 or 3 times to make each curve a sharp corner if that is required.
	Click Surface Menu, then Close

PIPE SURFACE

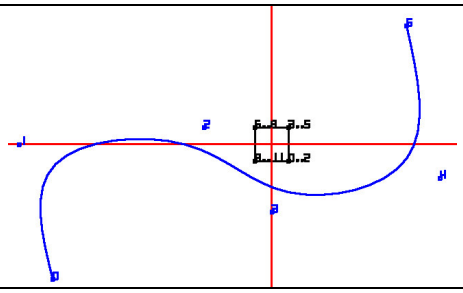
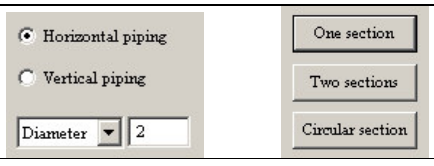
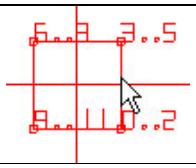


Sweeps a cross-section along a curve.



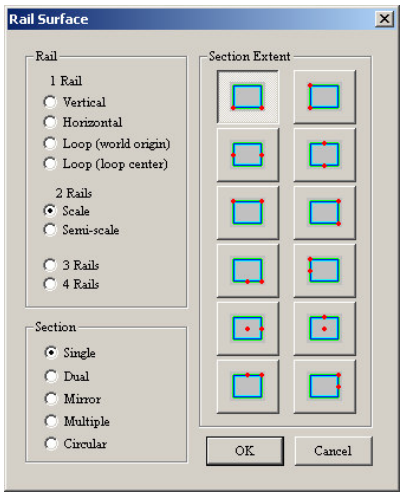
One Section: Use only one cross-section for the surface.	**Horizontal/Vertical Piping:** The piping orientation of the cross-section, in regards to the curve
Two Sections: Begin with one cross-section and end with another.	
Circular Section: Use a pre-set circular cross-section.	**Diameter/Radius:** Sets which dimension to use and the size, for a circular cross-section. Use the drop- down menu to choose between Diameter and Radius

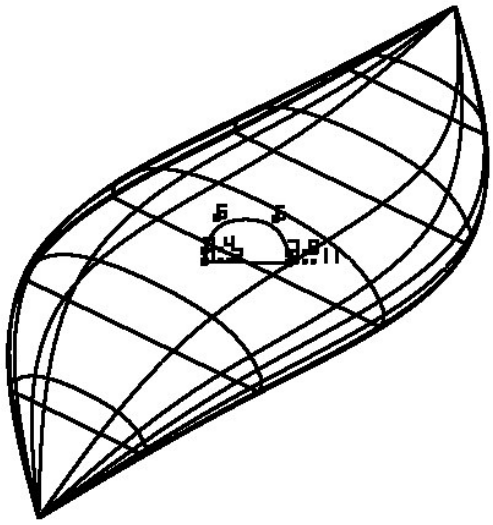
To Use:

	Draw the path,(or pipe) and cross-section (if required). Cross-section Curve must be closed, and MUST BE ON THE WORLD ORIGIN. Make sure the 'path' (or pipe) is selected (white)
	Click on "Pipe Surface" button
	Choose Vertical piping, or Diameter/Radius and size. Click "One Sec tion", "Two Sections" or "Circular Section"
	Click on cross-section(s), if necessary

RAIL SURFACE

Puts a cross-section between a set of curves (rails)





Rail:

1 Rail:

Vertical:	Places the cross-section between the vertical axis and a curve
Horizontal:	Places the cross-section between the horizontal axis and a curve
Loop (world origin):	Sweeps the cross-section between the WO and a curve
Loop (loop center):	Calculates the center of a loop and sweeps the cross-section between it and the curve

2 Rails:

Scale:	Places a cross-section between two rails, scaling width to height proportionately
Semi-Scale:	Places a cross-section between two rails. Cross-section remains original height

3 Rails:

As for 2 rails, but the 3rd rail provides a variable contour, (height), to the top of the section.

4 Rails:

As for 3 rails, but the 4th. Rail controlling the contour of the underside of the section.

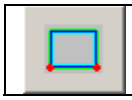
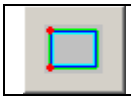
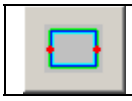
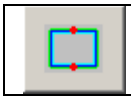
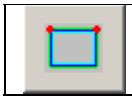
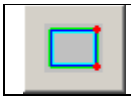
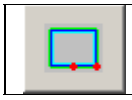
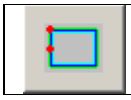
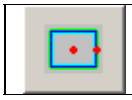
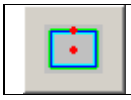
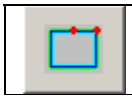
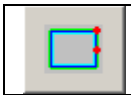
Section:

Single:	Use a single cross-section
Dual:	Gradually change from one cross-section at one end to another at the other end
Mirror:	Gradually change from one cross-section at either end, to another cross-section in the middle
Multiple:	Change between many cross-sections **and/or** determine where the change occurs
Circular:	Automatically use a pre-set circular cross-section

SCREEN PROMPTS, AT BOTTOM LEFT, GUIDE SELECTION OF THE RAILS WHEN PICKING.

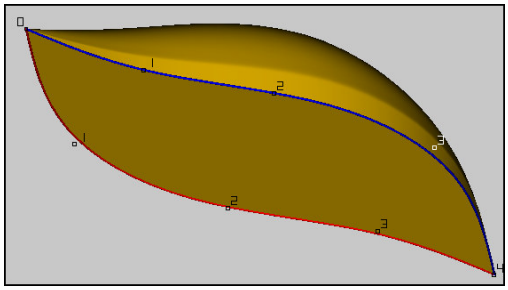
Section Extent:

This table controls the orientation of the cross section, even though it has been drawn on the same plane as the rails. The first, (top left), configuration is the default and is good for the majority of rail functions.

	Section between and on top of rails		Section between and to right of rails
	Section between and vertically centred between rails		Section between and horizontally centred between rails
	Section between and underneath rails		Section between and to left of rails
	Section horizontally centred above one rail, width radius set by 2nd rail		Section vertically centred, to the right of one rail, height radius set by 2nd rail.
	Section centred around one rail. Width radius set by 2nd rail.		Section centred around one rail. Height radius set by 2nd rail.
	Section horizontally centred below one rail, width radius set by 2nd rail		Section vertically centred, to the left of one rail, height radius set by 2nd rail.

LEFT AND RIGHT RAILS

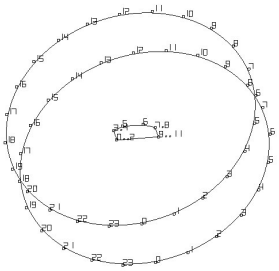
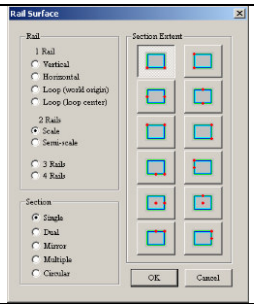
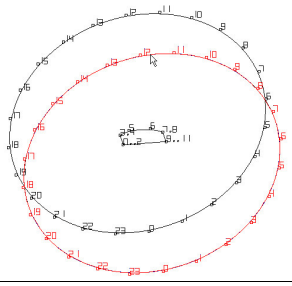
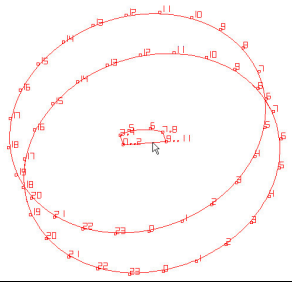
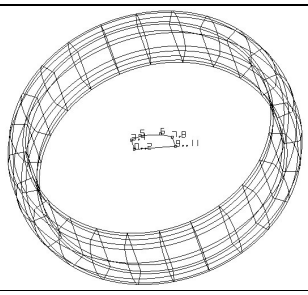
The screen prompts will ask you to pick ‘left’ and ‘right’ rails, which can b e important to get the result you want. The left and right are determined by the direction of the curves, which is always starting from CV ‘0’ .



EG. In the picture, the direction of the curves is left to right, (‘0’ to ‘4’) therefore the lower of the 2 r ails is the left rail

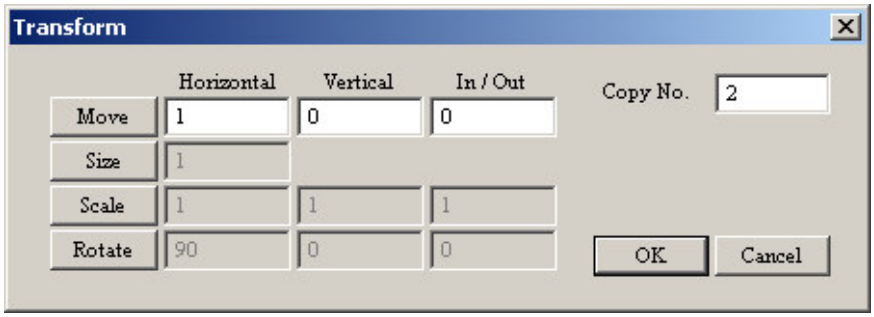
If the left and right rails were to be chosen in reverse, the cross-section would be upside-down, underneath the rails.

To Use:

	Draw curve(s). Draw cross-section(s)
	Click on Rail button
	Change settings as necessary. Click "OK"
	Click on rail(s)
	Click on Cross-section(s)
	When you've selected the last cross-section, the surface will be created.

TRANSFORM SURFACE:

Sweeps a cross-section according to the transform functions



Move/Size/Scale/Rotate:

The Transform functions being performed on the sections

Move:	Moves each section a distance from the previous
Size:	Resizes each section proportionately from the previous
Scale:	Resizes in one direction, each section from the previous
Rotate:	Rotates each section an angle from the previous

Horizontal / Vertical / In/Out:

The factors/measurements by which the functions are performed

Copy No.:

The number of times the section is copied to create the surface. Must be at least 2.

Combining Functions:

To perform multiple functions at the same time (ie. Move 3mm, rotate 30º and size up 3x), click on the relevant function buttons once. Size and Scale cannot be used together.

To Use:

1. Draw curve and keep selected
2. Click on "Surface" menu, then on "Transform"
3. Change settings as necessary
4. Click "OK"

OTHER SURFACE OPERATIONS:

CYLINDER:

Creates a pre-set cylinder, with a diameter and length of 2mm.

CONE:

Creates a pre-set cone, with a diameter and length of 2mm.

SPHERE:

Creates a pre-set sphere, with a diameter of 2mm.

REVERSE:

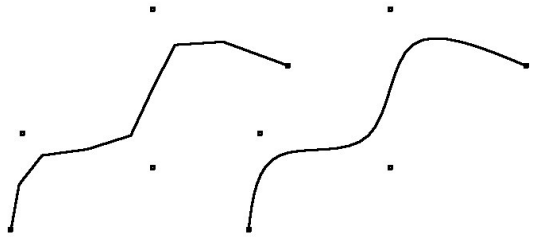
Reverses the order of CVs on the U-Curve

DIVIDE:

Puts a number of CVs/Sections between the existing CVs/Sections.

STEP:

Changes the number of times the computer calculates a curve between CVs. The default is 8 times. The more calculations there are, the less facetted the surface. (Normally used to increase the resolution prior to manufacture).



eg.
The surface on the left has a step of 2, whereas the surface on the right has a step of 8.

SWAP U/V:

Changes which curves are designated as U-Curves and V-Curves. Does not change the shape of the object.

FLIP NORMAL:

Flips the "Normal" of the surface. The "Normal" is an imaginary direction, running perpendicular to the surface, directly outwards.

OFFSET SURFACE:

Creates a new surface a distance off the original.

V-CURVES:

Close:	Closes the V-Curves of a surface
Open:	Opens the V-Curves of a surface
Reverse:	Reverses the direction of the V-Curves of a surface

MISCELLANEOUS MENU:

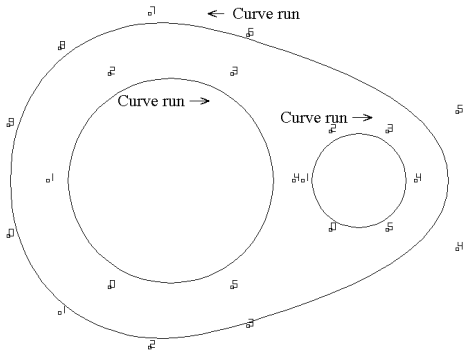
BOOLEAN:

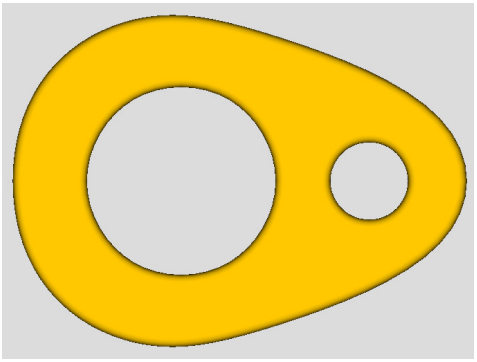
Creates an object from two (or more) existing objects. (see "Boolean Menu")

BLOCK:

Creates a Block Object.

A Block, like any solid, is comprised of curves. Instead of having two curves (one for the cross-section, and one joining the cross-sections), a Block object is like an extended surface, but uses curves to define positive and negative space. The anti-clockwise curves define positive space (solid) and clockwise curves, running in the opposite direction, create negative space (holes). Block objects cannot be deformed using the Deform commands.
Eg:

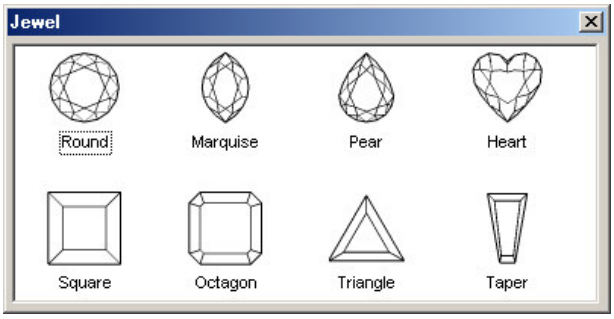




JEWEL:

Creates a pre-drawn jewel.

The jewels are 1mm x 1mm, except the Taper, which is 2mm x 0.8mm. The Jewels are not 1mm deep, however.

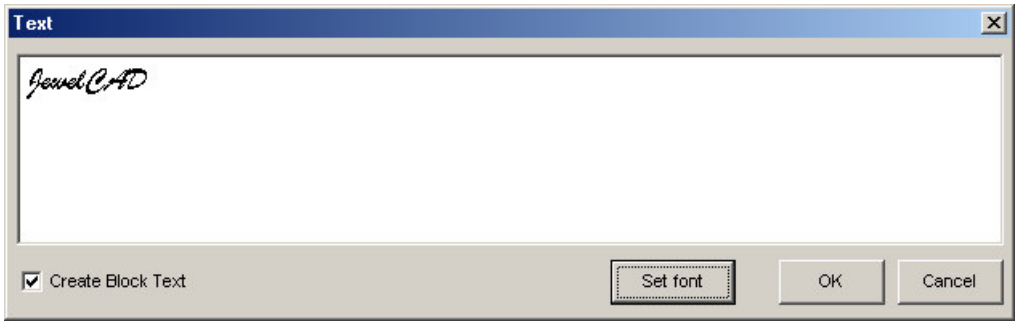


FACET OBJECT:

Flat Shaded:	shows individual facets when the object is rendered
Smooth Shaded:	smooths facets when rendered
Flip Normal:	reverses the Normal direction of Facet Objects
Extend to Solid:	creates an extended surface from a Facet Object

TEXT:

Adds text to the drawing.



1. Type text in the box
2. Click on "Set Font" and choose font, font style, size etc (just like in Word or Works)
3. If "Create Block Text" is ticked, when you click OK will open the Block Menu (See previous page). Uncheck to create curves first.
4. Click "OK"

Text is created as curves, but with point-to-point lines, not smooth curves.

Create Block Text:
Creates block surfaces from the text. Block objects cannot be deformed (bent, twisted etc).

Set Font:
Brings up a dialogue box, allowing you to alter Font, **Bold**, *Italics* etc and Font Size.

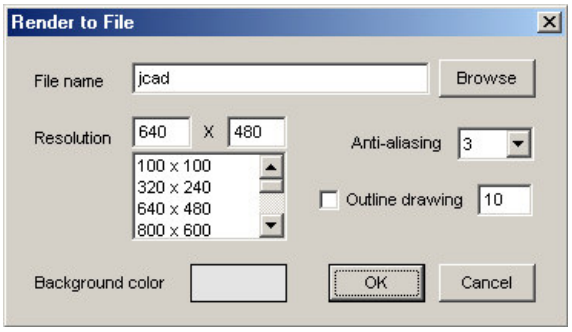
T-LINE:

Allows you to draw a T-Line. (construction line to define boundarys)

1. Click "T-Line"
2. Hold mouse button down in screen and drag:
   Horizontal for a Vertical T-Line, Vertical for a Horizontal T-Line

RENDER TO FILE:

Render the model and save as a bitmap file for printing, with facility to adjust resolution etc.



1. Position model in 3D View.
2. Select Render To File from Menu.
3. Change settings, as necessary
4. Click "OK". BMP file will be created.

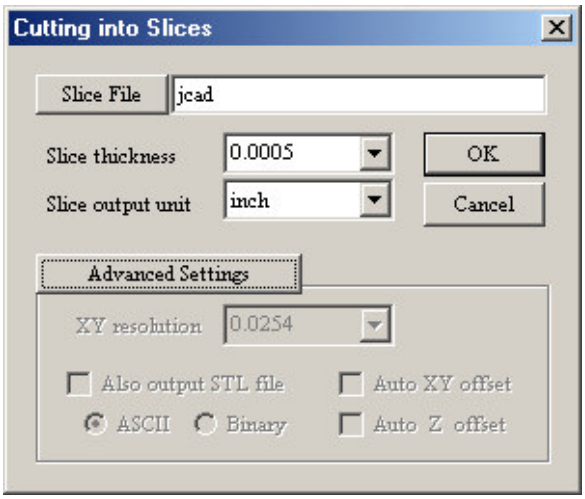
File Name (Browse):
Name the file and its location

Resolution:
The picture size, in pixels.

Anti-aliasing:
The amount of smoothing.

The resulting file can be opened in any graphics program to be printed.

CUT INTO SLICES:



Slices the model for Prototyping and saves as a .slc file.

1. The model is always sliced so that the cross sections are viewed in the TOP view.
2. Select Cut Into Slices from the Misc menu.
3. Change settings as required
4. Click Ok

Slice File:
The filename and location of the .SLC file Click Button to browse hard drive.

Slice Thickness:
The thickness of the slices, from 0.0127mm to 0.0762mm

Slice Output Unit:
Translates the arbitrary units of JewelCAD into an actual measurement for slicing. Drop menu down to change.

Advanced Settings:

XY Resolution:
Defines the detail of each slice. The higher the resolution, the higher the quality, but also a larger file size.

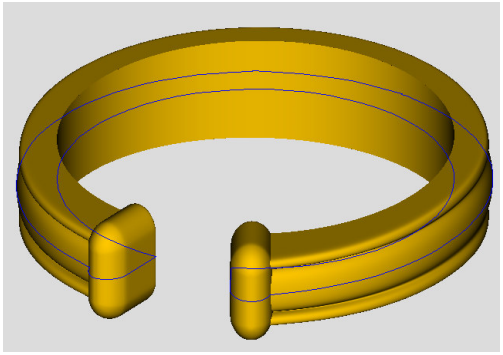
Also output STL File:
Translates the Slice file into an STL file after slicing. Can be either ASCII or Binary STL.

Auto XY offset:
Automatically moves the drawing so all co-ordinates are positive in the X/Y directions.

Auto Z offset:
Automatically moves the drawing so co-ordinates are positive in the Z direction.

SHOW SLICES:

Displays slices of a .SLC file.



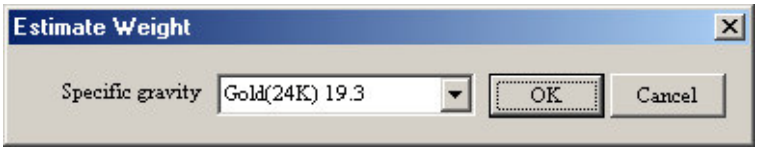
1. Select Show Slices from the Misc Menu
2. Will open last file that was sliced.
3. To open a different file, Click the open folder button to open another file.
4. Find and select file and click "Open"

The "<" button will display all layers.
Slicing a file and looking at the slices is a good way to check if objects are joined/overlapped etc. The slices are exactly what will be produced.

ESTIMATE:

Weight:

Calculates the weight of the drawing.



1. Select Estimate > Weight from the Misc Menu.
2. Type in Specific Gravity the desired material (ie. Diamond SG = 3.52)
3. Click "OK"

Volume:

Calculates the volume of the drawing

1. Select Estimate > Volume from the Misc Menu

Centre of Gravity:

Calculates the centre of gravity for the drawing. Use to check pendants will hang straight

1. Select Estimate > Volume from the Misc Menu

MEASURE DISTANCE:

Allows you to measure the distance between two points.

1. Make sure the drawing is in Wire frame.
2. Select "Measure Distance" from the misc Menu
3. Click on a point. The co-ordinates of the points, and the distance between them is displayed in the Status Bar. First measurement will be from the world origin to the point.
4. Click on next point. This measurement will be from the previous point.
5. Measurements at the surface can be made by viewing the drawing in 'Shading In Colour" Mode.
6. To exit from Measure Mode, click on Pick Button.

COUNT ROUND JEWEL:

Counts the number of round jewels in your drawing

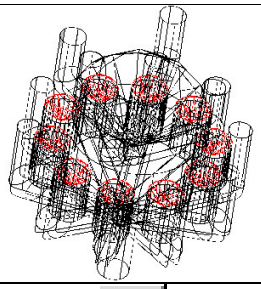
BOOLEAN MENU

Creates an object from one or more

UNION:

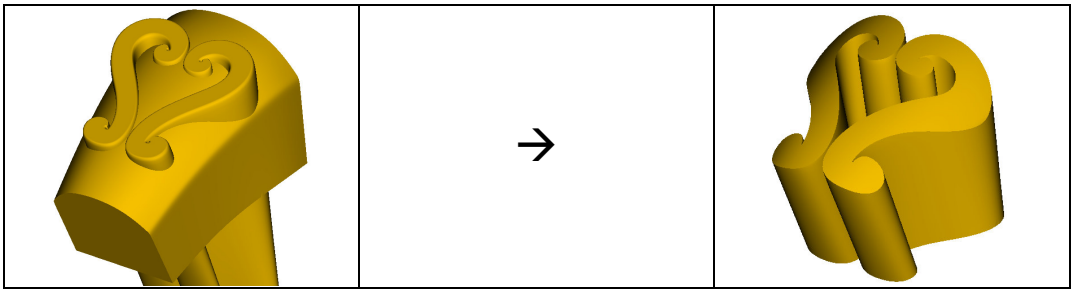
Joins 2 or more objects together.

To Use:

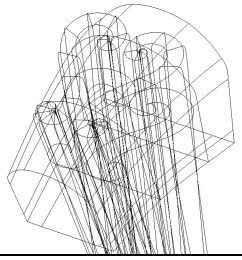
Select objects to be grouped	
Click on Boolean-Union button	

INTERSECT:

Leaves the material which is common to both of 2 overlapping objects.



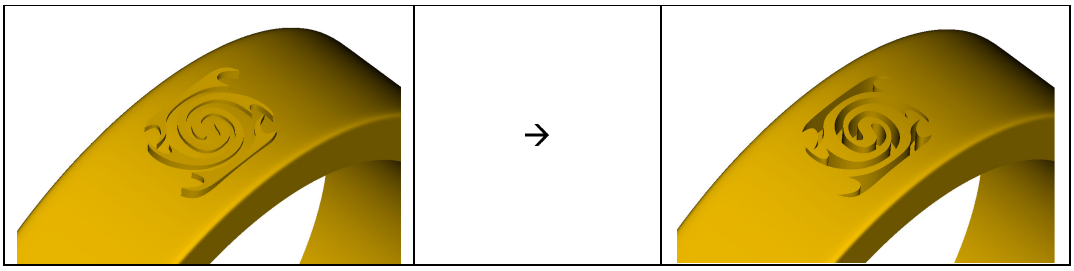
To Use:

Select two objects. (Cannot be more than two. Each object can be a Boolean object)	
Click on Boolean- Intersect Button	

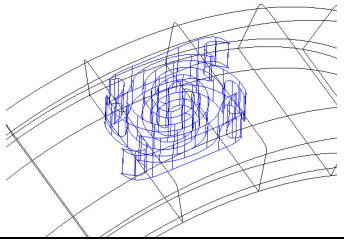
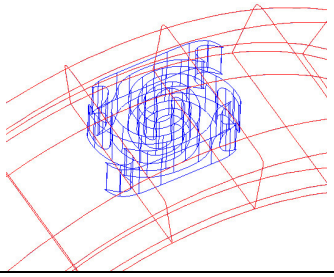
The object won't appear to change. However, a new object will be created.
Shade or Render the view to see the new object.

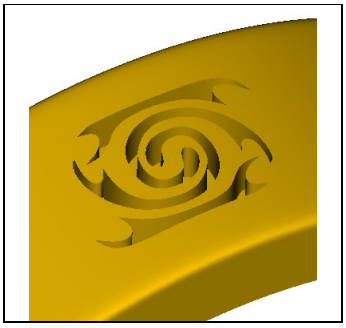
SUBTRACT:

Cuts one object out of another, where they overlap.



To Use:

Select object(s) to cut out	
Click on Boolean-Subtract button	
Click on object to cut from	



DIS-BOOLEAN:

Breaks a Boolean object up into its constituent parts

Appendix 1: Buttons

VIEW MENU

	Fine Snap	Reduces the size of the 'snap', for fine drawing work.
	Quick Wire Frame	Views drawing using a minimum number of lines.
	Normal Wire Frame	Views drawing using a normal number of lines.
	Wire Mesh	Views drawing as a wire mesh
	Fast Shading	Colours drawing simply. Does not show Boolean objects.
	Shading in Colour	Shades drawing, showing Boolean objects.
	Render	Renders drawing to look realistic.
	Front View	Views drawing from the front.
	Right View	Views drawing from the right.
	Top View	Views drawing from the top.
	Back View	Views drawing from the back
	Left View	Views drawing from the left
	Bottom View	Views drawing from the bottom
	3D View	Views drawing in rotatable 3D.
	Front and Right	Splits screen into front and right views.
	Top and Front	Splits screen into top and front views.

	Four View	Splits the screen into top, right, front and 3d views.
	Alt. Four Views	Splits the screen into bottom, left, back and 3d views.
	Pan Up	Moves the view up.
	Pan Down	Moves the view down.
	Pan Left	Moves the view left.
	Pan Right	Moves the view right.
	Zoom In	Zooms in on the drawing
	Zoom Out	Zoom out from the drawing
	Zoom Window	Zooms in on a specific area of the drawing.
	View All	Shows all of the drawing.
	View 1:1	Zooms the image so that 1cm on the drawing is 1cm on the screen
	Flip Up	Rotates the 3D view up.
	Flip Down	Rotates the 3D view down.
	Flip Left	Rotates the 3D view left.
	Flip Right	Rotates the 3D view right.
	Roll Left	Rolls the 3D view to the left.
	Roll Right	Rolls the 3D view to the right.
	Reset View	Resets the view.

TRANSFORM MENU

Move	Moves object along one axis using left mouse button. Use right mouse button to move in both axes.
Size	Resizes picked objects. Left button In all axes proportionally, Right mouse button will resize along one axis only.
Flip	Rotates object around either vertical or horizontal axis.
Rotate	Rotates object around in-out axis.
Object Axis	Makes functions work from the object's origin and axes, not the world origin.

COPY MENU

Cut & Paste	Cut and pastes objects.
Vertical Mirror Copy	Copies objects across the vertical centre-line.
Horizontal Mirror Copy	Copies objects across the horizontal centre-line.
180º Revolve Copy	Copies objects 180º revolved from original
Cycle Copy	Copies objects across both centre-lines.
Extend Copy	Copies objects in a direction. Number of copies and distance between objects must be specified.
Revolve Copy	Copies objects around the in-out axis. Number of copies and angle between objects must be specified.

DEFORM MENU

	Bend	Bends objects.
	Bend (2 Sides)	Bends objects in two directions. A doming effect
	Taper	Tapers objects.
	Taper (2 Sides)	Tapers objects in two directions
	Scaled Taper	Combines Resize and Taper functions.
	Scaled Taper (2 Sides)	Scale-Tapers objects in two directions
	Skew	Skews objects/points, pivoting on an axis
	Skew (2 Sides)	Skews objects/points, pivoting on an axis in two directions
	Twist	Twists objects around an axis.
	Skew-twist	Same as Twist, only preserves shape in the other view.
	Whirl	Whirls objects around centre-line. The further the points are away from the centre, the further they are rotated.
	UV-Map	Maps multiple objects onto a surface or curve, along all axes.
	Project-Map	Projects objects/points onto a surface or curve, along one axis.

CURVE MENU

	Simple Curve	Draws a curve point-by-point
	Vertical Mirror Curve	Any points drawn are mirrored across the vertical axis.
	Horizontal Mirror Curve	As above, only mirrored across the horizontal axis.
	180º Revolve Curve	Copies points, 180º rotated from each other.
	Cycle Curve	Any points drawn are mirrored across both axes.
	Extend Curve	Repeats points a chosen distance away in a straight line.
	Revolve Curve	Repeats points at a chosen angle, around a circle.
	Circle	Draws a circle.
	Close Curve	Joins start- and end-points together.
	Open Curve	Opens a curve at start and end points.

SURFACE MENU

	Extend Surface	Creates a 3D object with straight sides from a cross-section curve.
	Vertical Revolve Surface	Revolves a cross-section curve around the vertical centre-line.
	Horizontal Revolve Surface	Revolves a cross-section curve around the horizontal centre-line.
	Loft Surface	Joins cross-section curves together to form a surface.
	Pipe Surface	Sweeps a cross-section curve along a singe path,(curve).
	Rail Surface	Sweeps a cross-section curve between rails.

BOOLEAN MENU

	Union	Makes all selected objects into one object.
	Intersect	Creates an object where two selected objects overlap.
	Subtract	Cuts one object from another.
	Dis-Boolean	Undoes any Boolean action that has been performed on an object.

Appendix 2:

Approximate Ring Diameters

Size	Diameter	Size	Diameter	Size	Diameter
A	12.05	L	16.4	W	20.7
B	12.45	M	16.8	X	21
C	12.9	N	17.2	Y	21.4
D	13.25	O	17.6	Z	21.8
E	13.65	P	18	1	22.2
F	14	Q	18.4	2	22.5
G	14.4	R	18.75	3	22.8
H	14.8	S	19.1	4	23.2
I	15.2	T	19.5	5	23.6
J	15.6	U	19.9	6	24.6
K	16	V	20.3		

Appendix 3:

Approximate weights of diamonds. Based on Round Brilliant-cut.

Carat	Diameter	Carat	Diameter	Carat	Diameter
125pc (0.008)	1.25	0.20	3.8	1.50	7.4
0.01	1.4	0.22	3.9	1.60	7.6
70pc (0.015)	1.5	0.23	4.0	1.75	7.8
0.02	1.7	0.25	4.1	1.90	8.0
40pc (0.025)	1.8	0.30	4.2	2.00	8.2
0.03	2.0	0.33	4.4	2.15	8.4
0.035	2.1	0.38	4.6	2.25	8.6
0.04	2.2	0.40	4.8	2.50	8.8
0.05	2.4	0.47	5.0	2.65	9.0
0.06	2.5	0.50	5.2	2.85	9.2
0.07	2.7	0.60	5.4	3.00	9.4
0.08	2.8	0.65	5.6	3.15	9.6
0.09	2.9	0.75	5.8	3.35	9.8
0.10	3.0	0.80	6.0	3.50	10.0
0.11	3.1	0.85	6.2	3.75	10.2
0.12	3.2	0.95	6.4	4.00	10.4
0.14	3.3	1.00	6.5	4.25	10.6
0.15	3.4	1.10	6.6	4.45	10.8
0.16	3.5	1.17	6.8	4.75	11.0
0.17	3.6	1.25	7.0	5.00	11.2
0.18	3.7	1.33	7.2		

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